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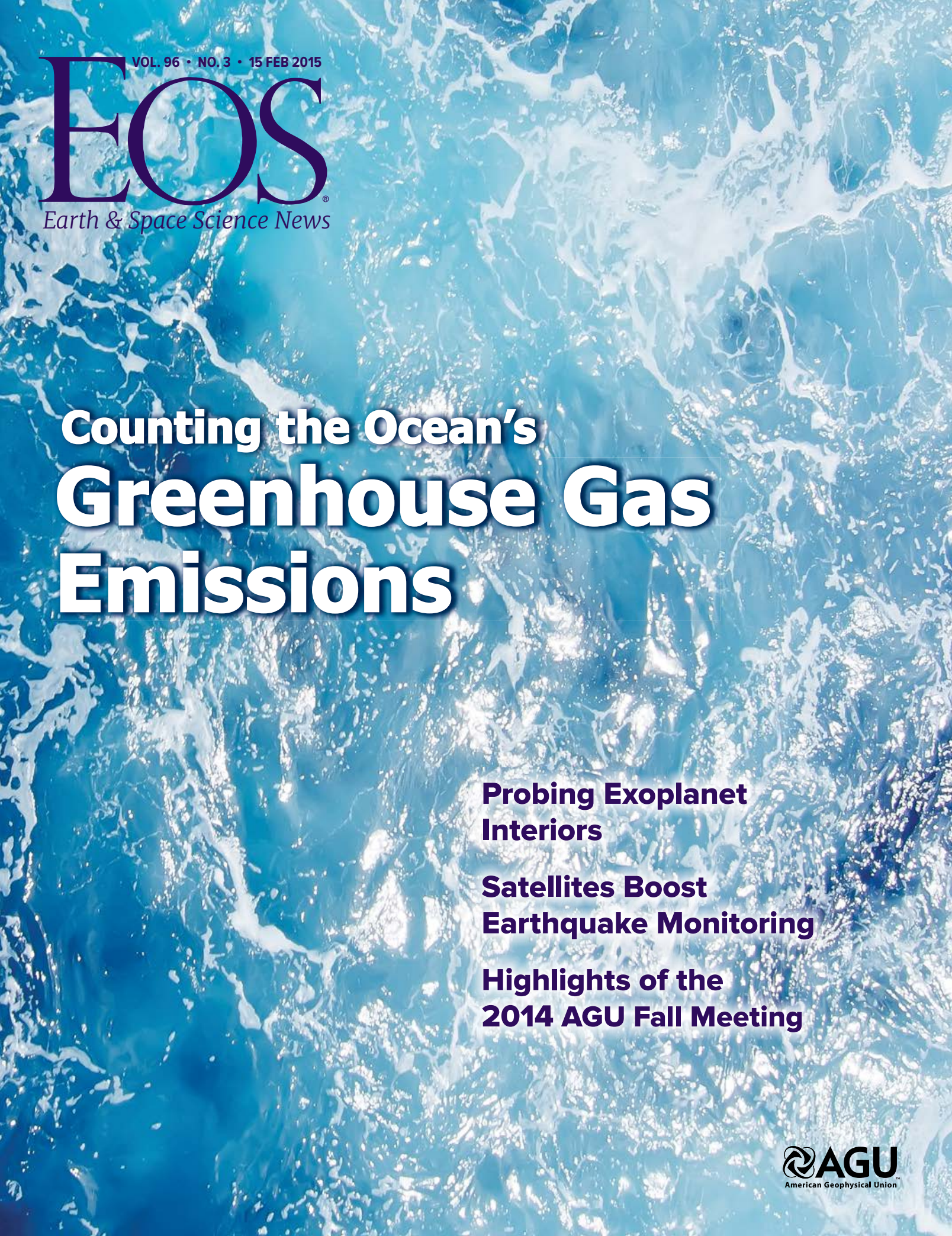
EOS

Earth & Space Science News



Counting the Ocean's Greenhouse Gas Emissions

Probing Exoplanet Interiors

Satellites Boost Earthquake Monitoring

Highlights of the 2014 AGU Fall Meeting

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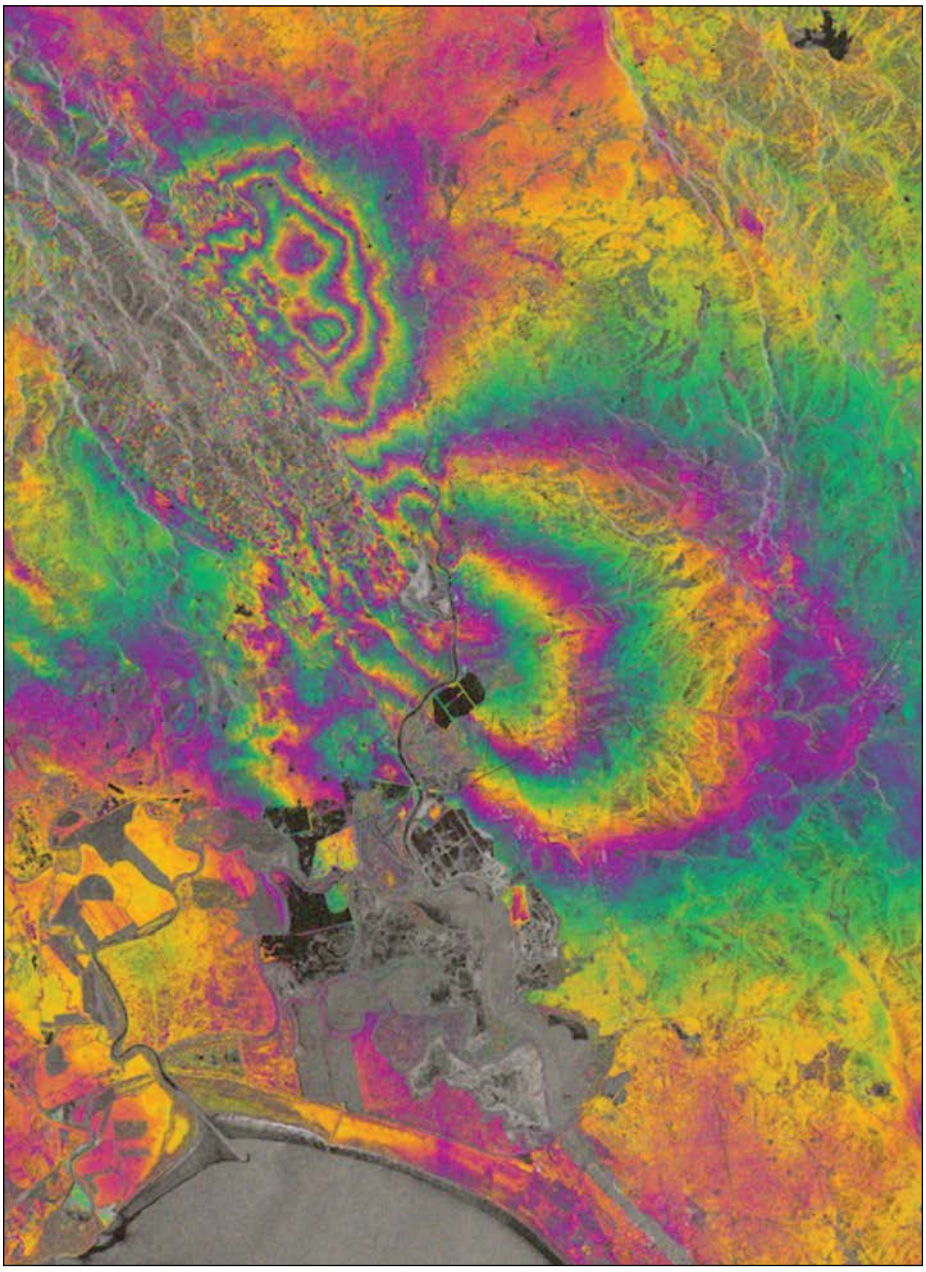

PROJECT UPDATE

Earthquake Monitoring Gets Boost from a New Satellite

Europe's Sentinel-1A spacecraft and its extraordinary images of slip from the South Napa earthquake herald a new era of space-based surveillance of faults.

PROJECT UPDATE

Counting the Ocean's Greenhouse Gas Emissions

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Wave Ripples Spaced by Flow Downstream of Ripple Peaks

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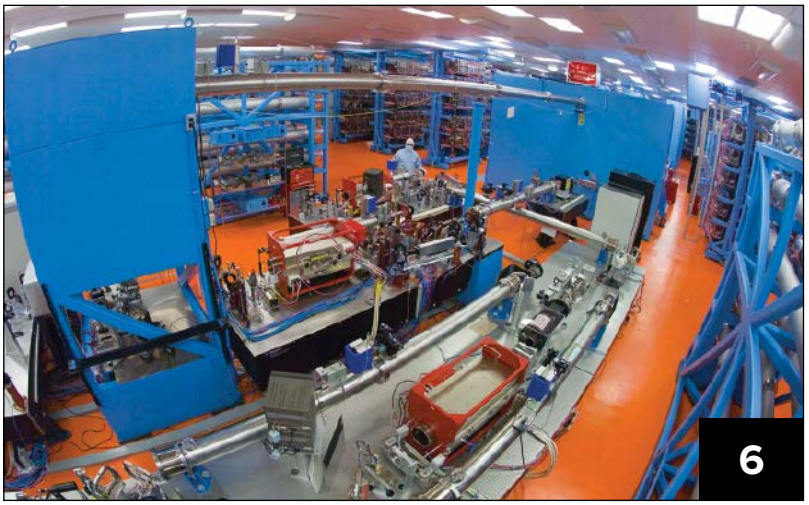

EOS.

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Christine W. McEntee, Executive Director/CEO

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D. C. Project Aims to Cut Most Storm Water Runoff Problems

Randy Showstack

Vice President Joe Biden and other dignitaries at a 16 January briefing at a Clean Rivers Project site on the banks of the Anacostia River in Washington, D. C. From left to right: Biden, Secretary of Agriculture Tom Vilsack, Washington, D. C. Mayor Muriel Bowser, Rep. Eleanor Holmes Norton (D-D. C.), and U.S. Environmental Protection Agency Administrator Gina McCarthy.

As a prelude to the State of the Union address on 20 January, the Obama administration promoted its efforts on climate change and on infrastructure projects. The administration announced on 16 January several measures to increase investments in drinking water and wastewater systems and in other infrastructure projects.

Among these, the U.S. Environmental Protection Agency (EPA) launched a Water Infrastructure and Resiliency Finance Center to help local and state governments gain access to federal loan and grant programs and to promote public-private collaborations to address water infrastructure needs. The U.S. Department of Agriculture also announced a Rural Opportunity Investment Initiative to identify investment opportunities in water, energy, and other infrastructure projects.

In addition, administration and local officials recently highlighted D. C.'s $2.6 billion Clean Rivers Project (see http://bit.ly/CleanRivers). The effort aims for a 96% reduction of combined sewage overflows into the city's waterways to improve water quality while also promoting resilience to climate change, they said.

Clean Rivers Project

Combined sewage overflows occur during heavy rain events when sewage and storm water—which travel through the same pipes—spill over into the nearest water body. In Washington, D. C., those water bodies are the Anacostia and Potomac rivers and Rock Creek.

The project broke ground in 2011. It involves building at least 15 miles of underground tunnels about 100–110 feet beneath the city to store the sewage and runoff in pipes until it can be conveyed to a water treatment plant. Construction of the longest underground segment, the 13 mile long Anacostia River Tunnel, began in 2014. That portion of the project is expected to be completed in 2018. Tunnel-boring machines equal in length to about 150 yards and that are more than 20 feet in diameter are digging primarily through a seam of sediment and heavy clay.

The effort is benefiting from some innovative financing. DC Water, which oversees the project, issued "century bonds" with a 100-year final maturity to match the life expectancy of the tunnels.

At a 16 January news event at a project site on the bank of the Anacostia River, Vice President Joe Biden and other officials said the project not only would help to clean the city's water but could also be a driver for economic growth. Biden said the project provides decent-paying jobs and that businesses want to locate in places with good infrastructure and clean water.

"If we are going to lead the world in the 21st century," he commented, "we have to have the most modern infrastructure in the world." Biden said that more than 700 cities across the country have outdated water and sewer systems.

Building in Resiliency

EPA Administrator Gina McCarthy called the Clean Rivers Project "a miracle of modern engineering practices." She added that through projects that modernize the nation's water infrastructure, the agency's new finance center "is going to help communities improve water and wastewater systems and build resilience in the face of a changing climate." McCarthy said the country would need more than $600 billion over the next 20 years to maintain and improve its water infrastructure.

Tommy Wells, director of Washington, D. C.'s District Department of the Environment, stressed that the project is important in part because of changing conditions resulting from climate change. "We have to be sure that we have resilient cities, and the resiliency is tested by the climate change that we have seen with Hurricane Sandy but especially with Hurricane Katrina," he told *Eos*. "Substantial climate change can shut down a city and you can lose billions of dollars not just in restoration of infrastructure but in lost business, lost revenue."

Wells continued, "There is going to be more and more flooding around the country. This project, with [its] miles of tunneling, means that if there is a flash event of rain, which can and will happen again, we will be able to manage at least this river. We will be able to manage up to 98% of the rainfall year round, no matter how much rain comes in. So [the project] helps immensely on managing flood control."

He added, "Frankly, we are going to have to figure out how to slow down if not reverse climate change in order for us to be able to have a resilient city environment."

Preparation for More Frequent Storms

George Hawkins, chief executive officer and general manager of the District of Columbia Water and Sewer Authority, said the Clean Rivers Project "is a mammoth construction," but it is solving a long term problem of combined sewage overflows.

Hawkins also focused on the relationship between resiliency and climate change. "The kinds of storms that cause the flooding that we are talking about are happening more frequently," he told *Eos*. "Where you might have had this happen once every many years in the past, now it's happening all the time. So, the need to have the overflow captured in a tunnel rather than going to a river or a neighborhood is more. The problem that we are solving is more prevalent now."

By **Randy Showstack,** *Staff Writer*

Underground Water Reserves Found in Hawaii's High Country

Flickr user gribbly, CC BY 2.0

A view from Hawaii's Saddle Road between Mauna Loa and Mauna Kea. Nineteen endangered species inhabit this saddle region—at an elevation of roughly 1900 meters, it is one of the world's rare tropical, subalpine, dryland ecosystems.

On the surface, water seems scarce in the remote saddle region between the Mauna Loa and Mauna Kea volcanoes on the island of Hawaii. The area gets between 5 and 15 inches of rain a year, according to Peter Peshut, a biologist who manages the Natural Resources Office of the Pohakuloa Training Area (PTA), a U.S. Army facility in the region.

But below the surface, tests reported at the 2014 AGU Fall Meeting reveal groundwater pockets at high elevations. The groundwater, which could be pumped to the surface to supply much-needed water or developed into a source of geothermal electricity, could help solve the region's water and energy woes.

An Unexpected Resource

The U.S. Army maintains a primary interest in water and energy resources to serve the overall needs of the 35- by 25-kilometer PTA. The area provides training for units of all U.S. and allied militaries and can accommodate up to 2300 people.

"Currently, the Army spends nearly $2 million annually for tanker truck operations to supply water at the remote PTA," Peshut told *Eos*. However, the apparent extent of the water resource at relatively shallow depth bodes well for the development of a water production system, he said.

Not only is the water close to the surface, but its deeper reaches get progressively hotter. Temperatures at depth may exceed 250°C, enough heat to create steam from extracted water. This steam can drive turbines and generate electricity.

"Energy providers are eager to explore alternative sustainable power resources," Peshut said. He noted that Hawaiians pay the highest price per unit of energy in the country, about $0.34 per kilowatt-hour.

However, the discovery of a geothermal resource does not guarantee a drop in prices, which would depend on private industry's development costs and business practices as well as market forces. And even if electricity were to become more affordable, some may not welcome development of this resource.

Near Pāhoa, a half-hour drive and 1700-meter descent from the PTA, the Puna Geothermal Venture provides electricity to a quarter of the island's population. Yet "there was a great deal of opposition to the geothermal work we had done down in Puna," Donald Thomas, a geochemist at the University of Hawaii at Mānoa in Honolulu, Hawaii, told *Eos*. "The community just simply doesn't want industrial activity in their region."

Deepening Understanding of Island Geology

The previously accepted groundwater model held that most of the island above sea level consists of porous rocks, Thomas explained. The only stored groundwater was believed to be within less permeable, relatively limited dike systems found on the rift zones and at the centers of volcanoes.

However, a 3500-meter borehole drilled near the island's shoreline in 2007 offered new clues to hidden water reserves. Researchers expected to find a thin layer of freshwater underlain by saltwater—indicative of ocean waters penetrating the island's permeable rocks. Instead, they found multiple layers of freshwater down to 3000 meters below sea level. "The very deep water near the shoreline implied that we had to have high-elevation freshwater in the interior to displace sea water to those depths," Thomas said.

To find out, Thomas and his colleagues cooperated with U.S. Geological Survey researchers to create a two-dimensional image of a cross section of the island, showing among other factors, remotely measured electrical and magnetic resistivity from the surface to several kilometers below ground.

The image indicated groundwater at elevations as high as 1000 meters above sea level, so they dug a test well. Below the ground, "we found freshwater standing at about 1500 meters above sea level," Thomas said.

New measures of resistivity indicated hydrothermal activity at 2–3 kilometers depth, plus evidence of magma storage at around 5 kilometers.

More Freshwater Elsewhere?

The team expects that their method could find more freshwater reserves throughout the island and on other islands in the Hawaiian archipelago. In particular, they're testing to the north of Mauna Kea, in the nearby Waimea region, for aquifer reserves and geothermal potential. Depending on what they find, industries, government agencies, and residents could soon face choices about whether or how to develop water and energy resources.

For now, though, Thomas and his team will analyze the water they found. They will measure the total dissolved solids and sodium, potassium, calcium, and magnesium. Finding an easily accessible resource is just the beginning. "Water quality," said Thomas, "that's the other half of the picture."

By **Leslie Willoughby,** *Freelance Writer*

NSF Geosciences Report Provides Updated Roadmap

A new strategic planning report, the introduction of three new division directors, and budget concerns were the key topics at a 16 December 2014 town hall meeting by the U.S. National Science Foundation's Directorate for Geosciences (NSF GEO).

The report, *Dynamic Earth: Geo Imperatives & Frontiers* 2015–2020, (see http://bit.ly/NSFDynamicEarth) provides a near-term plan for NSF-supported geoscience research by outlining imperatives and frontier areas for GEO. It was released at a 16 December town hall held at the AGU's Fall Meeting in San Francisco.

Issued by NSF's Advisory Committee for the Geosciences (AC GEO), the report states that support of GEO core research programs "is the highest priority" of the directorate. In addition to the overall emphasis on core research, the report focuses on directorate-wide imperatives. These are plans that the report states must be accomplished "to advance knowledge and address critical national needs" within each of four thematic areas: research, community resources and infrastructure, data and cyberinfrastructure, and education and diversity.

Geoscience Imperatives

Within the research theme, imperatives include cross-divisional work to improve the understanding of and resilience to hazards and extreme natural events as well as to support basic research that focuses on the nexus of food, energy, and water. For the second theme, community resources and infrastructure, the highest priorities are NSF's Major Research Equipment and Facilities Construction (MREFC) projects. Data and cyberinfrastructure imperatives include focusing on integrated data management infrastructure across the geosciences. Among the education and diversity imperatives are increasing undergraduate exposure to the geosciences, preparing the geoscience workforce, and broadening participation of underrepresented groups.

The report, which is an update to GEO's 2009 Geo Vision document (see http://bit.ly/GeoVision), also identifies four frontier areas that could rise to become imperatives. These are Earth systems processes that cross the land/ocean interface, high-latitude ocean-atmosphere-ice-ecosystem interactions and processes, urban geosystem science, and research on early Earth. These or other emerging themes could become imperatives "if GEO and the community collectively agree that the timing is right for increased resources and effort. Frontier activities require an infusion of new resources in order to be fully supported," the report states.

A High-Level Set of Priorities

While the *Dynamic Earth* report focuses on directorate-wide priorities, various GEO divisions are developing and refining division-level priorities to complement the report and provide more details about core research and program activities.

"Strategic planning is difficult no matter what. Strategic planning in difficult budgets is really tough," GEO director Roger Wakimoto told *Eos*, stressing that the document is "a road map" that focuses on directorate-wide priorities.

> "Strategic planning is difficult no matter what. Strategic planning in difficult budgets is really tough."

"This isn't a 'kitchen sink' document," he said. "People think that 'if my project doesn't get in here, it's subject to termination.' And that's not true at all. What we want to tell people is that at least at the [GEO] level, these are things that are really near and dear and important to us."

He said, for example, that although there are many important facilities supported by the directorate, MREFCs are by definition a foundation priority. "That doesn't mean the other facilities are unimportant," Wakimoto said. But "I would say we lose credibility if we didn't highlight those as the most important facilities at the GEO level.

New Division Directors

At the town hall meeting, Wakimoto introduced three new division directors: Paul Shepson, Atmospheric and Geospace Sciences; Carol Frost, Earth Sciences; and Rick Murray, Ocean Sciences (OCE). Wakimoto told *Eos* that while the strategic plan is important, bringing three new division directors on board "takes precedence" over the plan.

The new division directors "provide the stability, [and] they represent their disciplines," he stated.

Rising Costs of Facilities

Debbie Bronk, acting OCE division director at the time of the town hall, spoke about the need to balance ocean science research and infrastructure needs. She said that a new U.S. National Research Council Decadal Survey of Ocean Sciences could help with that balance.

"Over the last 5 to 6 years, historically the budget that NSF OCE has had has gone mostly into research, with maybe 40% into facilities," she explained. "And now we are in a situation where that is flipping. We have flat budgets, we have increasing facility costs, and the core programs really have been hit."

According to Wakimoto, NSF "has been struggling" in terms of facilities. "When budgets are difficult, flat, maybe slightly declining, there really is this drain on the core program to support things that are very near and dear to our hearts, and that is facilities," he said.

Geoscience Budget Concerns

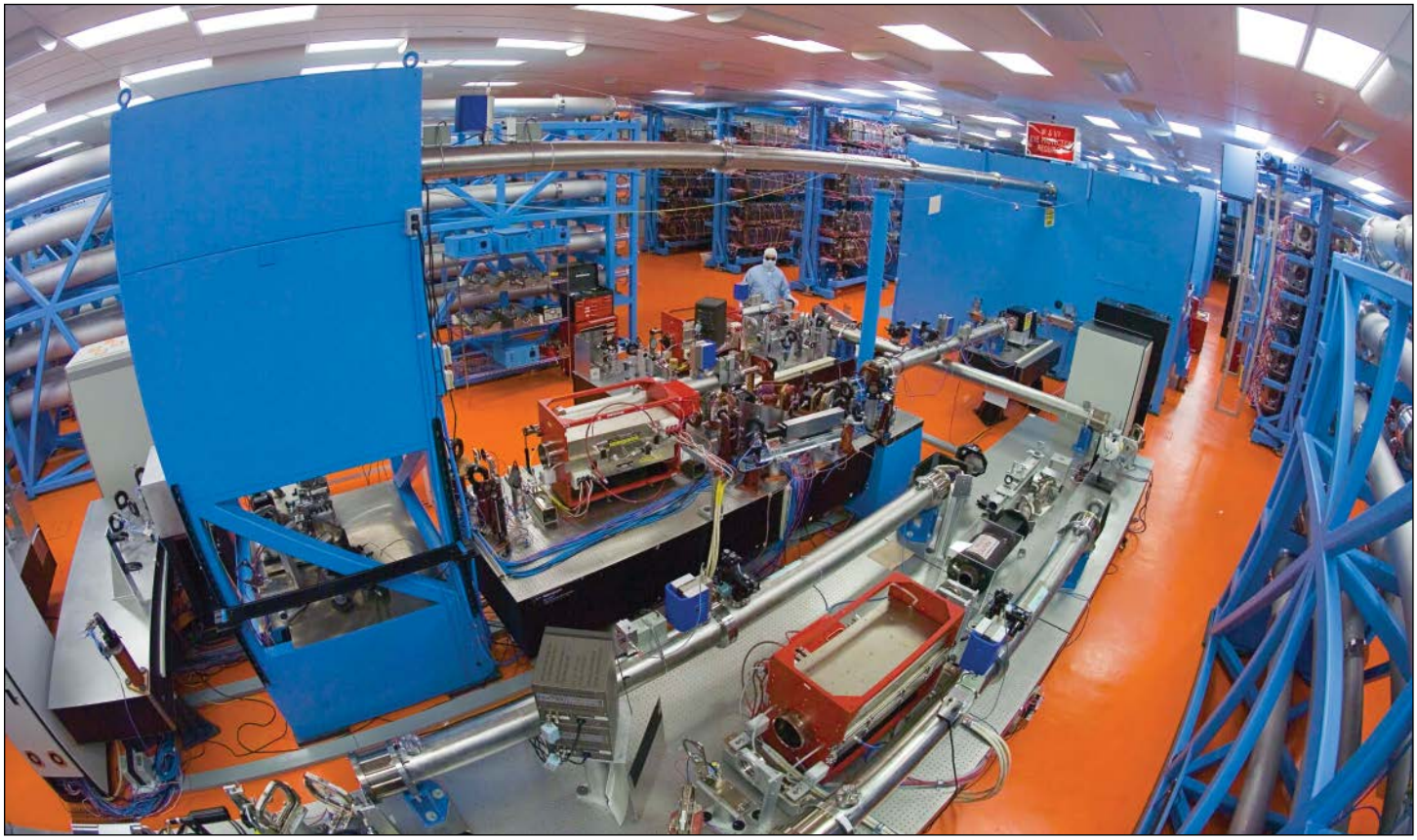
Wakimoto also expressed concern to *Eos* about some language included in a House of Representatives report related to the fiscal year (FY) 2015 omnibus appropriations act that became law on 16 December. That language, included within a section on research and related activities, states, "Any increases provided above the request and not otherwise specified below shall be applied to math and physical sciences; computer and information science and engineering; engineering; and biological sciences." The language does not include the geosciences.

Wakimoto told *Eos* that he is "a little nervous that Congress feels that it has to come in and allocate specifically to individual directorates." He said that while Congress "has every right" to make the allocation decisions, directorate-specific allocation "is a very rare event."

The appropriations act provides NSF overall with a 2.4% increase above the FY 2014 funding level. However, Wakimoto said that implementation of the language would mean that funding for the geosciences directorate would be "held flat" at the FY 2014 level. NSF is required to submit its spending plan to Congress within 45 days of the legislation's enactment. According to an NSF spokesperson, the agency expects to meet the target deadline. The Obama administration is planning to release its FY 2016 federal budget proposal on 2 February.

By **Randy Showstack,** *Staff Writer*

Probing Exoplanet Interiors Through Lab Simulations



An engineer operates the OMEGA laser at the University of Rochester. Scientists used the laser to subject samples of stishovite to high pressures and temperatures. The data helped scientists understand how the material could behave in the interiors of large exoplanets.

With a building-sized laser and 20 technicians to operate it, scientists have replicated what they could only dream of investigating with spacecraft: the deep interiors of gas giants in our own solar system and rocky exoplanets much larger than Earth.

Scientists calculate that temperatures within Earth's inner core reach up to 5000–7000 Kelvin (between 8540°F and 12,140°F) and pressures reach 350 gigpascals (more than 3 million atmospheres. For comparison, the deepest part of the ocean that humans have explored is slightly more than 1000 atmospheres). Larger planets in the solar system have even hotter cores that exist under even higher pressures; scientists believe that the cores of Uranus and Neptune, for example, are squeezed by 450–500 gigapascals of pressure and reach temperatures up to 6000–8000 Kelvin.

These conditions could not be experimentally explored—until now.

A paper published on 22 January in *Science* (doi:10.1126/science.1261507) documents how scientists used laser-induced compression waves to study how silica—a common Earth material that is often used as a model for planetary mantles—behaves under intense heat and pressures.

Through these experiments, "we recreate the interior of planets in the lab, and we study the physical properties of matter in the extreme conditions that exist inside planets," Marius Millot, lead author on the study and a physicist at Lawrence Livermore National Laboratory at University of California, Berkeley, told *Eos*.

"By studying high-pressure and temperature conditions, we can study the matter deep inside the planets that we cannot [examine] directly by launching a probe," he continued. This information can be used to learn more about planetary formation and evolution.

Enter the Laser

Using the 10-meter-tall and 100-meter-long laser at the University of Rochester, Millot's team shot laser beams at millimeter-sized samples of stishovite, a highly dense form of silica. Stishovite is rarely found at Earth's surface (meteor impact sites hold minute quantities) so the researchers had to partner with colleagues in Germany to prepare synthetic samples.

When the laser hits the target in a vacuum, the force and temperature of the laser vaporizes the stishovite's surface in a process called ablation, and a rebound effect (imagine the kick of a cannon) pushes an incredibly forceful compression wave into the mineral,

Millot explained. The compression wave is so strong and moves so fast that it becomes a shock wave (similar to the boom of a supersonic aircraft). By observing how the mineral reacts to the shock wave, which generates enormous heat and pressure, the scientists can see how a similar mineral might behave in the cores of giant, gassy planets or rocky planets larger than Earth.

The experiments revealed that at pressures similar to what scientists believe occur at the core–mantle boundaries of rocky exoplanets larger than Earth, silica and iron have a similar melting point. Because Earth's inner and outer cores are made up of a solid and liquid iron–nickel alloy, respectively, these findings have implications for planetary evolution and makeup.

© Eugene Kowaluk

The system fires, sending a laser beam that creates a shockwave of intense pressure through the stishovite target while vaporizing its surface. The behavior of the mineral under these conditions helps scientists better understand the cores and mantles, and thus the evolutionary history, of large planets.

Rethinking Exoplanetary Evolution

The traditional view of terrestrial planetary formation dictates that a newly formed rocky planet would be molten and would eventually cool after millions of years, leaving a solid mantle over a liquid outer core. However, this view rose from studies appropriate to our own Earth, and Millot's research suggests that it is time to rethink exoplanetary evolution, said Paul Asimow, a professor of geology and geochemistry at California Institute of Technology, who was not involved in the research.

Because the study finds that liquid silica can coexist with solid iron at pressures greater than that at Earth's core–mantle boundary, rocky exoplanets larger than Earth could have liquid lower mantles over frozen cores and thus have much different evolutionary histories, Asimow said. In other words, rocky exoplanets could host a magma ocean at their core–mantle boundaries, similar to what Earth might have experienced early in its evolution.

Furthermore, Millot found that silica at high pressures and temperatures becomes highly electrically conductive. He suggests that this deep layer of highly conductive liquid silica could help the exoplanet form a magnetic field.

However, Asimow pointed out that because silica itself is not thought to be found in the lower mantle, more research is needed to investigate how other materials such as certain perovskites, which do exist near the core–mantle boundary, behave under higher temperatures and pressures.

"Now that we're realizing there are planets out there where the mantle extends to much higher pressure, with the core at pressure yet higher still," Asimow continued, "we need to go and understand materials in extreme conditions."

By **JoAnna Wendel,** *Staff Writer*

Observing/Modeling the Atlantic Meridional Overturning Circulation

2014 U.S. AMOC Science Team Meeting
Seattle, Washington, 9–11 September 2014

Continuous direct measurement of the Atlantic Meridional Overturning Circulation (AMOC) around the globe is placing new constraints on ocean model simulations.

These observation efforts include decade-long research in the subtropical North Atlantic at 26.5°N through the Rapid Climate Change—Will the Atlantic Thermohaline Circulation Halt Meridional Overturning Circulation and Heatflux Array (RAPID-WATCH/ MOCHA) project. Data also is supplied by a 5-year effort in the South Atlantic near 30°S called the South Atlantic Meridional Overturning Circulation (SAMOC) project. In addition, new observational deployments are better quantifying circulation in the subpolar North Atlantic through the Overturning in the Subpolar North Atlantic Program (OSNAP).

Advances in ocean modeling, the Coupled Model Intercomparison Project 5 (CMIP5) archive of climate model output, and numerous state estimation products now allow increased examination of processes that affect variability in AMOC and associated climate changes in the Atlantic Ocean. Moreover, the need for using knowledge of the state of the Atlantic Ocean to enable decadal climate prediction brings additional motivation to improve our understanding of AMOC.

The U.S. AMOC Science Team, comprising scientists from about 50 AMOC research projects, met in September 2014 in Seattle, Wash., to share findings and foster integration of observations and models to accelerate progress in understanding AMOC and its impacts. The meeting focused on four objectives: (1) evaluation and implementation of observational efforts; (2) estimates of AMOC state, variability, and change; (3) understanding mechanisms of variability and the potential for predictability of AMOC; and (4) the impact of AMOC changes on climate, cryosphere, regional sea level, ocean carbon biogeochemistry, and marine ecosystems.

As an emergent property of ocean dynamics, observations of AMOC provide essential metrics for evaluating ocean-only and coupled models as well as ocean reanalysis. There is little agreement in the representation of AMOC among different ocean reanalyses and with the 26.5°N observational time series. To make progress, it is important that error estimates accompany the time series of observational AMOC estimates and that adjustments in model variables be provided with reanalysis products to allow a more comprehensive comparison between models and observations.

Participants acknowledged the need for continuous and extended AMOC observations throughout the Atlantic Basin. Improved communication among observing system groups, among the modelers, and between the observationalists and modelers can help develop integrated, coherent evaluation of AMOC and the associated heat transport state, variability, and change, with continued focus on linkages between the South Atlantic and the Southern Ocean, and the North Atlantic and the Arctic. To sustain observations over the long term within budgetary constraints, investigations are needed to evaluate the potential for existing and emerging technologies (e.g., deep Argo, gliders) to provide cost-effective approaches for monitoring AMOC.

Evaluating the role of AMOC in climate variability and change—including the rate of warming, connections to tropical cyclone activity, and shifts in tropical precipitation patterns—continues to be a focus. Research on how AMOC variations can affect changes in land and sea ice, regional sea level, ocean carbon uptake, and ecosystem dynamics is also important. Better coordination with other research communities (e.g., cryosphere, coastal ocean, ocean carbon biogeochemistry) is needed to accelerate understanding of the impacts of AMOC variability and change on the Earth system.

There is little agreement in the representation of AMOC among different ocean reanalyses.

The U.S. AMOC Program is an interagency program organized within the U.S. Climate Variability and Predictability program, with projects funded by NASA, the National Oceanic and Atmospheric Administration, the National Science Foundation, and the Department of Energy. The U.S. program coordinates closely with the UK Rapid Program. Additional details about the meeting can be found at http://bit.ly/ClivarAMOC.

By **LuAnne Thompson**, School of Oceanography, University of Washington, Seattle; email: luanne@uw.edu; **Gokhan Danabasoglu,** National Center for Atmospheric Research, Boulder, Colo.; and **Michael Patterson,** U.S. Climate Variability and Predictability Project Office, Washington, D. C.

Investigating Climate Change from the Stratosphere to Space

8th Workshop on Long-Term Changes and Trends in the Atmosphere
Cambridge, United Kingdom, 28–31 July 2014

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Laser beams of the ground-based lidar instruments at the Leibniz Institute of Atmospheric Physics in Kühlungsborn, Germany, slice through to an altitude of about 120 kilometers, collecting data in atmospheric regions along the way.

Multidecadal changes to Earth's upper atmosphere (~15–500 kilometers altitude) are becoming increasingly relevant to the future of our world. Societal impacts of upper atmospheric climate change derive from our technological reliance on this region, through which satellites orbit and electromagnetic signals propagate, and from the boundary conditions it imposes on the troposphere. It is therefore critical that we quantify and understand changes occurring at all levels within the coupled atmospheric system.

Increasing concentrations of greenhouse gases (which exert a cooling influence in the upper atmosphere), stratospheric ozone depletion, varying solar and geomagnetic activity, and secular change of Earth's magnetic field are some of the drivers of changes in the stratosphere (~15–50 kilometers), mesosphere (~50–90 kilometers), thermosphere (~90–500 kilometers), and ionosphere (embedded in the mesosphere and thermosphere). At a July 2014 workshop, 49 participants from nine countries discussed the latest research on multidecadal changes in these atmospheric regions.

One challenge of studying upper atmospheric climate is that available data sets are typically sparse or short compared to tropospheric data. Accordingly, a major workshop focus was the selection of statistical tools to characterize climate and to detect and attribute long-term changes. The participants identified and examined appropriate techniques for rigorous uncertainty assessment.

One challenge of studying upper atmospheric climate is that available data sets are typically sparse or short compared to tropospheric data.

Several presenters used coupled climate models to investigate the tropospheric climate response to changes in the stratosphere. These included geoengineering via solar radiation management through stratospheric aerosols and the reduction in stratospheric temperatures that might occur should the Sun enter a prolonged grand solar minimum. The regional response in surface climate to such forcing strongly depends on how the stratosphere is perturbed.

In the stratosphere, mesosphere, and lower thermosphere, significant progress has been made in measurement and modeling of the carbon dioxide (CO_2) concentration trend, which is the expected dominant driver of thermal changes in this region. Extended satellite observations of temperature, heating rates, noctilucent clouds, and composition are now available to investigate the response to natural and anthropogenic forcing. Simulations reveal strong heterogeneity among the responses of different metal species (e.g., sodium, potassium) to temperature and composition changes.

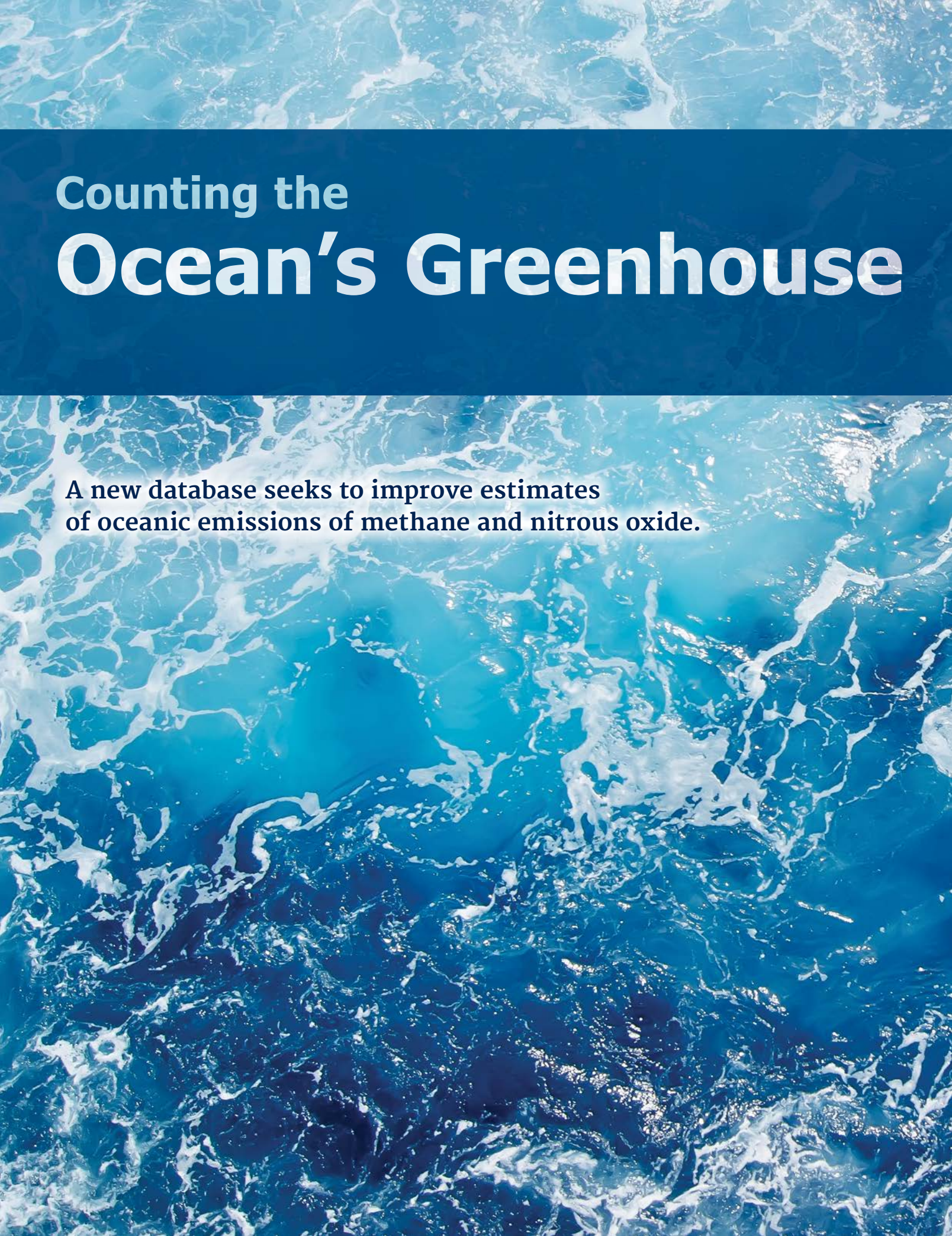
In the upper thermosphere, anthropogenic cooling trends and mass density decreases estimated from sophisticated models are in good agreement with satellite drag observations. Orbital debris simulations indicate that prolonged reduction of thermospheric density may induce a dramatic increase in space debris (atmospheric drag is currently the only mechanism for debris removal).

Discussion of ionospheric changes included novel techniques for exploiting archived radio wave propagation data, changes in neutral composition, and the relative effects of geomagnetic field evolution versus CO_2 increases. For example, centennial simulations indicate that the change in magnetic field can produce larger local changes in electron density than those related to increasing CO_2.

More information about the workshop can be found at http://bit.ly/upperatmo. A joint special section of *Journal of Geophysical Research: Atmospheres* and *Journal of Geophysical Research: Space Physics* will detail the presented results. The workshop was sponsored by the British Antarctic Survey, the International Association of Geomagnetism and Aeronomy, the Scientific Committee on Solar-Terrestrial Physics, and the Royal Astronomical Society. The next workshop in this biennial series will be held in 2016 in Kühlungsborn, Germany.

By **John. T. Emmert**, Space Science Division, U.S. Naval Research Laboratory, Washington, D. C.; email: john.emmert@nrl.navy.mil; **Daniel R. Marsh**, National Center for Atmospheric Research, Boulder, Colo., and **Ingrid Cnossen**, British Antarctic Survey, Cambridge, UK

Counting the Ocean's Greenhouse



A new database seeks to improve estimates of oceanic emissions of methane and nitrous oxide.

Gas Emissions

By Annette Kock and Hermann W. Bange

Shutterstock/anmo

To understand how Earth's climate will change in the future, scientists need to know how much heat-trapping gas is going into the atmosphere today. However, oceans' emissions of two major greenhouse gases, methane (CH_4) and nitrous oxide (N_2O), vary dramatically in time and space. With a centralized digital resource, the Marine Methane and Nitrous Oxide (MEMENTO) database, information on CH_4 and N_2O concentration measurements from around the globe are collected to help researchers more precisely quantify these oceanic emissions.

Oceanic CH_4 can arise from shallow sediments, and both CH_4 and N_2O are produced by ocean-dwelling microbes. Although only a relatively small fraction of global CH_4 emissions—around 2%—come from the ocean (including coastal areas), oceans are a major source for atmospheric N_2O, providing around 25% of the total. When it reaches the stratosphere, N_2O attacks ozone, destroying it on a global scale.

Estimates of oceanic emissions are based on extrapolations of concentrations measured at the ocean's surface or results from model studies. For example, using the data set of *Weiss et al.* [1992], *Nevison et al.* [1995] calculated the first global field of surface ocean N_2O concentrations to estimate the marine N_2O source to the atmosphere.

However, the fluxes of N_2O and CH_4 can vary substantially from day to day and from place to place, meaning that even with recent improvements in measurement techniques and increased measurements, global emission estimates are still highly uncertain [see *Ciais et al.,* 2013]. Millions of measurements taken at different times and covering the globe are needed for researchers to more precisely estimate how much gas is being emitted.

MEMENTO Ups the Game

MEMENTO, an initiative that began in 2009, is the first attempt to systematically compile all global data on oceanic CH_4 and N_2O measurements. It archives data taken not only at the ocean surface but also from the deep ocean. As curators of the data set, our goals are to see how oceanic concentrations of the gases vary in time and space and to provide more precise global emission estimates of oceanic CH_4 and N_2O to the climate research community.

MEMENTO already includes original data from more than 180 measurement campaigns, which have provided

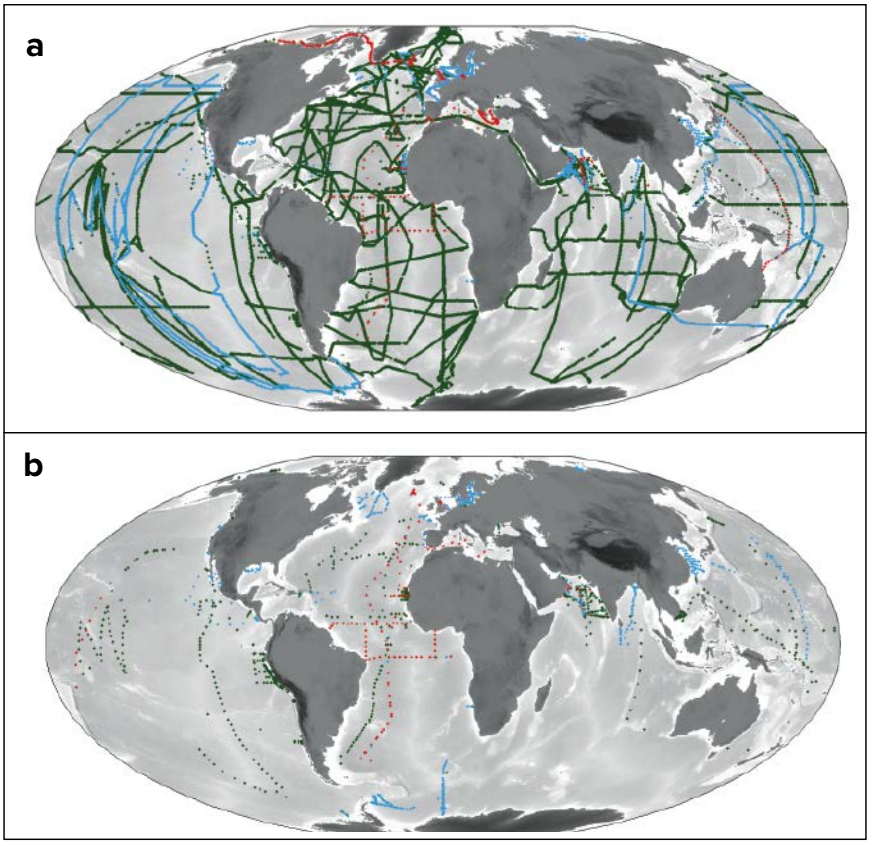


Fig. 1. (a) Locations of surface and (b) depth profile (stations with sample depths greater than 10 meters) of N_2O (green), CH_4 (blue), and collocated N_2O and CH_4 (red) measurements included in MEMENTO as of January 2015.

more than 20,000 CH_4 and more than 100,000 N_2O measurements over the past 50 years (see Figure 1 for sampling locations). These data sets include dissolved gas concentrations along with information on sampling position, sampling depth and time, and, if available, data on ocean temperature and salinity as well as oxygen and nutrient concentrations.

If available, we also include atmospheric measurements from the same campaign, such as air temperature and air pressure, usually sampled a few meters above sea level height. We also add to all submissions the contact information of the researchers who provided the data, their related publications, and if available, a link to the host center of the original data sets.

An Emphasis on Quality

We put all data submissions imported to MEMENTO through a systematic quality control procedure to guarantee that essential metadata are available and to minimize erroneous entries. If measurements lack information on sampling position, sampling time, and sampling depth (for oceanographic data), we do not import them into the database. In addition, we apply a first-order range check to all imported variables to exclude obviously incorrect data entries, such as negative concentrations, erroneous date formats, or data positioned over land.

CH_4, N_2O, and oxygen data are imported in their original units. In a second data-processing step, we will calculate global surface fields and depth profiles in common units. Missing temperature and salinity data will be supplied from external data sources.

A Work in Progress

We regularly update the database with newly available data sets and continuously improve it by including additional meta-information, allowing additional data formats, and implementing new data quality control criteria.

In addition, we are working closely with the recently initiated Scientific Committee on Oceanic Research (SCOR) Working Group 143, entitled "Dissolved N_2O and CH_4 measurements: Working towards a global network of ocean time series measurements of N_2O and CH_4." As an additional quality flag for our data, we will implement

If measurements lack information on sampling position, sampling time, and sampling depth (for oceanographic data), we do not import them into the database.

standard procedures that are developed within the working group for measuring N_2O and CH_4.

As we expand MEMENTO, we will also build on the experiences researchers have gained from existing databases such as the Surface Ocean CO_2 Atlas (SOCAT; http://www.socat.info), the Global Surface Seawater Dimethylsulfide Database (GSSDD; http://saga.pmel.noaa.gov/dms), and the Halocarbons in the Ocean and Atmosphere Database Project (HalOcAt; https://halocat.geomar.de). Specifically, we are looking to create best practices on how to structure data archives, methods for checking data quality, and ways to make data archives more user friendly.

A Resource for the Research Community

We intend for MEMENTO to serve as a living resource from which researchers can pull quality-controlled oceanic CH_4 and N_2O data for a variety of purposes. Researchers have already begun using the database to produce important results. For example, *Zamora et al.* [2012] and *Suntharalingam et al.* [2012] used MEMENTO data to model N_2O production and consumption processes on global and regional scales. *Freing et al.* [2012] used the database to compute global N_2O production rates from the in situ measurements. A list of publications associated with MEMENTO is available at https://memento.geomar.de/publications.

MEMENTO data are freely available to interested users, who can access the database via the MEMENTO website (https://memento.geomar.de). We would like to expand our database, so please consider adding your CH_4 and N_2O data. Contact us (akock@geomar.de) to obtain the log-in information to the database and information on how to submit your data to MEMENTO.

Acknowledgments

MEMENTO is supported by European Cooperation in Science and Technology (COST) Action 735, the Surface Ocean – Lower Atmosphere Studies Project Integration Programme (http://www.bodc.ac.uk/solas_integration/) and the German Federal Ministry for Education Research project Surface Ocean Processes in the Anthropocene, Grant FKZ 03F0660A. The database is receiving technical support from the Kiel Data Management Team at GEOMAR Helmholtz Centre for Ocean Research.

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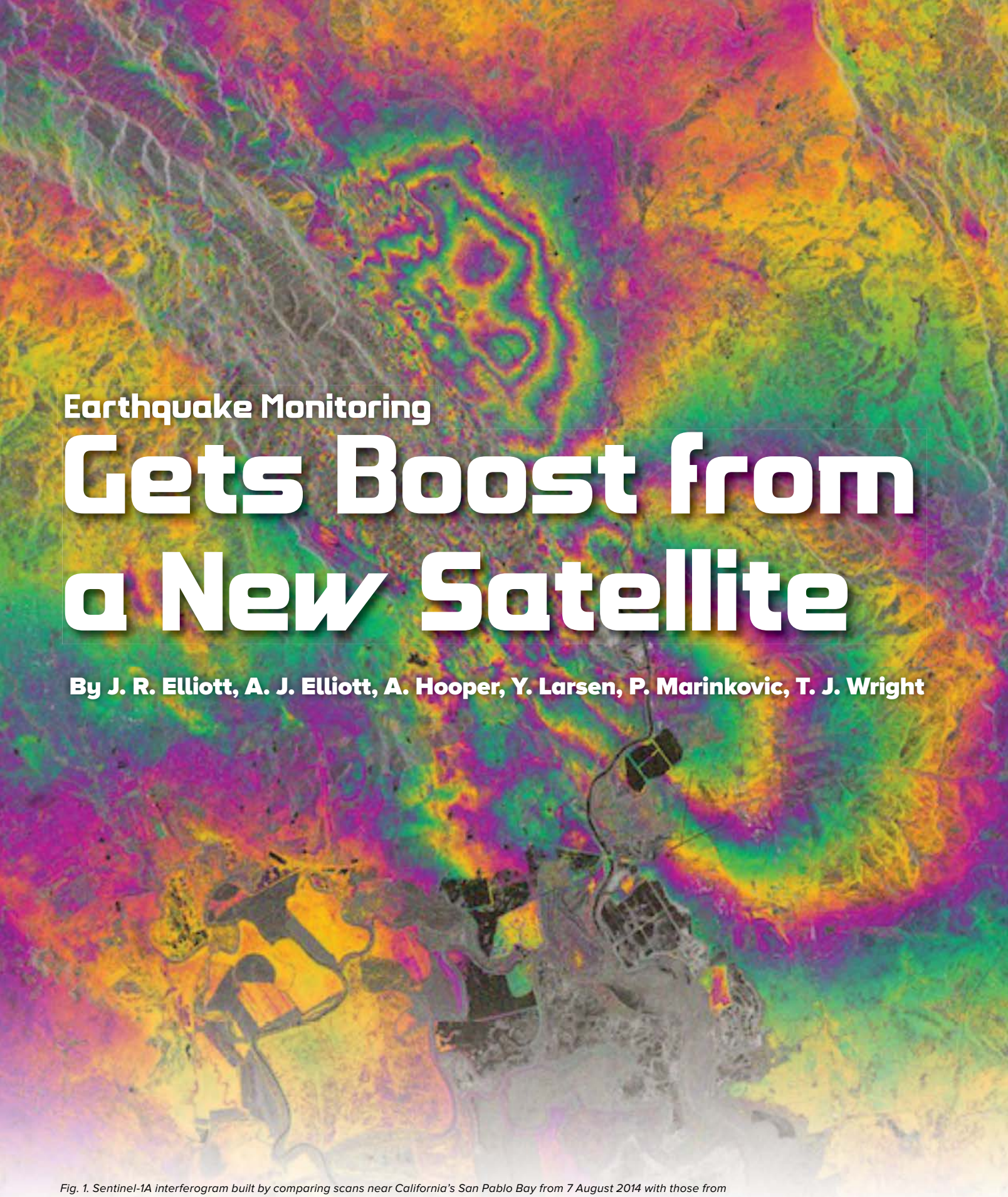
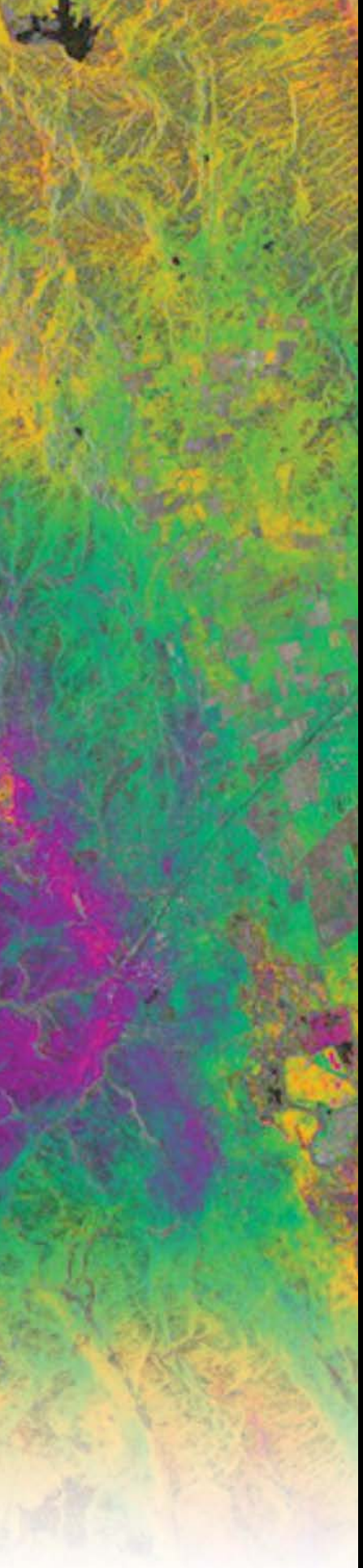


Earthquake Monitoring

Gets Boost from a New Satellite

By J. R. Elliott, A. J. Elliott, A. Hooper, Y. Larsen, P. Marinkovic, T. J. Wright

Fig. 1. Sentinel-1A interferogram built by comparing scans near California's San Pablo Bay from 7 August 2014 with those from 31 August 2014. The image shows ground displacement contours (changes in color represent displacement of 2.8 centimeters) of motion toward and away from the satellite due to the 24 August South Napa earthquake. The satellite looks westward and down and therefore measures both horizontal motion along the fault and vertical motions at the ends of the fault.



On 24 August 2014, the San Francisco Bay area shook in an M_w = 6.0 earthquake, the region's largest in 25 years. The tremors injured roughly 200 people, killed 1 person, and damaged buildings near the quake's epicenter in the southern reaches of California's Napa Valley. It also set off a scientific scramble to measure the fault's movement and marked the dawn of a new age of earthquake satellite monitoring thanks to a recently launched spacecraft: the European Space Agency's Sentinel-1A.

For more than 2 decades, space-based radar satellites have been measuring how the ground moves with extraordinary precision and spatial resolution. Comparing relative elevations taken from the same places at different times helps scientists to understand the dynamics of a variety of geophysical phenomena, including earthquakes, volcanoes, landslides, glacier flow, and ground subsidence [*Burgmann et al.*, 2000].

However, past satellite radar missions were neither designed nor optimized to target locations on Earth that specifically undergo rapid surface changes. As a result, data on dynamic regions of Earth's surface are often intermittent, poorly targeted, haphazardly collected,

The launch of Sentinel-1A marks a radical increase in our ability to monitor our dynamic, restless planet.

Austin Elliott

Damage in Napa, Calif., after the M_w = 6.0 South Napa earthquake, which shook the region on 24 August 2014.

and, in some cases, collected through means that scientists struggle to afford.

The launch of the first satellite in the European Commission's Sentinel-1 constellation on 3 April 2014 changed that, marking a radical increase in our ability to monitor our dynamic, restless planet.

Sentinel-1A, now fully operational, will be the first satellite to acquire radar data systematically and frequently over all the tectonic and volcanic areas on Earth. The satellite's potential was demonstrated by how precisely it monitored ground deformation from the South Napa earthquake as well as the further tectonic motion that occurred in the months since.

How Can Sentinel-1A Measure Earthquake Slip?

Sentinel-1A maps an earthquake's slip with its interferometric synthetic aperture radar (InSAR). SAR works by sending out pings of microwaves, which hit the Earth's surface and reflect back to the satellite. The strength of the microwaves reflected back as the satellite scans allows scientists to create an image of the terrain below.

InSAR goes beyond this process—it constructs an image not just with the strength of the reflected radar beam but with the phase of the microwave bounced back to the satellite [e.g., Hooper et al., 2012]. By comparing the difference in phase in images taken before and after an earthquake, the shift in the distance to the target—and therefore small ground motions—can be measured to better than centimeter-level precision. Using these ground displacements, scientists can then model the inferred slip that occurred on the fault plane at depth.

Unlike previous satellite radar missions, Sentinel-1A was specifically designed to monitor ground deformation. The satellite flies in a much smaller orbital tube in space and can see farther, greatly improving the quality of data collected.

Sentinel-1A and the 2014 South Napa Earthquake

The South Napa earthquake was the biggest to hit the San Francisco Bay Area since the 1989 M_w = 6.9 Loma Prieta earthquake (Figure 1). The shallow earthquake struck the Napa Valley at 03:20 local time on 24 August, according to the U.S. Geological Survey's (USGS) National Earthquake Information Center, with the epicenter located just south of Napa, a city with a population of 77,000.

The earthquake shook just weeks after Sentinel-1A had reached its final operational orbit and was the first geophysical event the satellite caught with both before and after

scans. The event proved to be a powerful demonstration of the satellite's capabilities, revealing not only the deformation that occurred due to the earthquake itself but also the further slow, shallow fault motion in the weeks following the quake.

The earthquake slipped mainly along a previously partly mapped portion of the West Napa Fault zone, an area thought to store a small component of the potential seismic energy through this part of California [*d'Alessio et al.*, 2005]. The first interferogram created by Sentinel-1A shows that the eastern side of the rupture moved about 10 centimeters in a southeastward direction, matching surface observations by scientists from the University of California, Davis, and the USGS.

Typically, ground motions in California follow strike-slip patterns, in which different regions of crust slide past each other along the fault. However, away from the fault trace, particularly near the ends of the rupture, significant vertical motion can also deform the ground.

Sentinel-1A reveals all this motion in great detail. The small surface displacements measured in the interferogram agree with the small offsets measured in the field by geologists surveying the fault rupture, who found displacements in roads and curb stones of about 10–20 centimeters (A. E. Morelan and C. Trexler, personal communication, 2014).

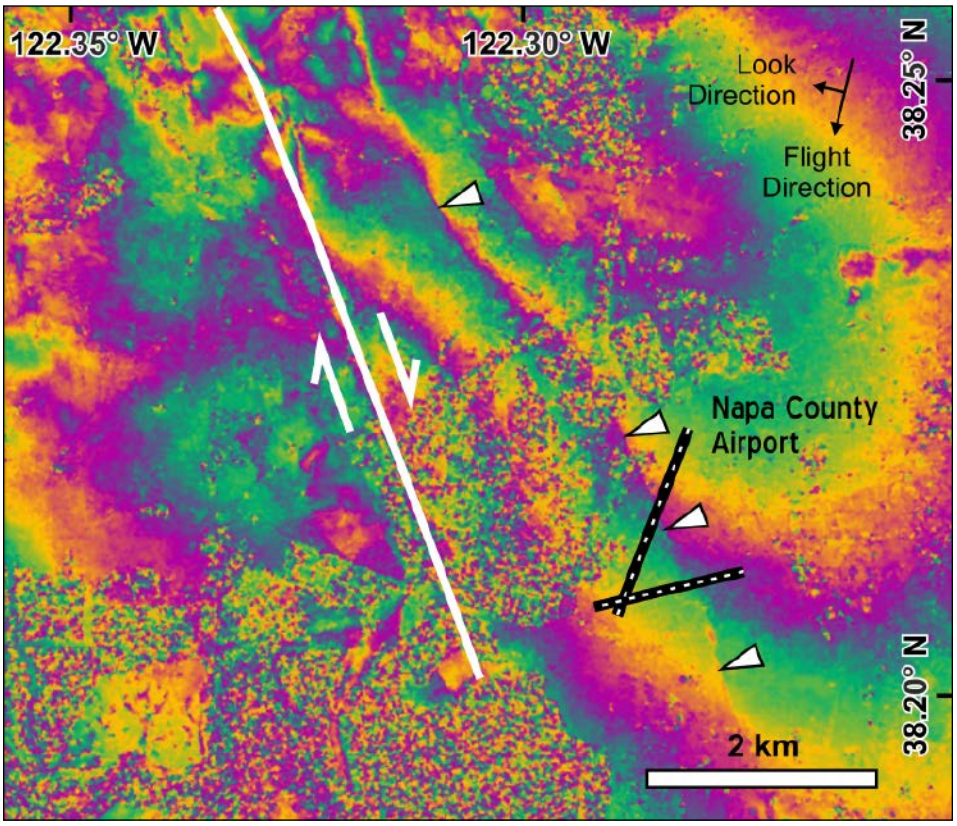


Fig. 2. Enlarged view of the deformation field around Napa County Airport showing the main rupture to the west of the airport and a discontinuity in the phase (marked by white triangles) across the runways (thick black lines).

Documenting the Earthquake's Ripple Effect in Space and Time

The interferogram also revealed other portions of the fault system that moved slightly in this event. Sharp lines in the interferogram, known as phase discontinuities, show minor movements on other faults, such as the part of the West Napa Fault zone that runs under Napa County Airport (Figure 2). This information, useful for illuminating other active parts of fault systems, can help direct future field investigation looking at fault activity.

On 12 September 2014, Sentinel-1A acquired a third image over the South Napa earthquake rupture. The sharp discontinuity in this interferogram (Figure 3) shows further slip of about 2 centimeters along the fault after the main quake, beautifully confirming other widespread field observations.

The rupture and afterslip were also captured by other satellites (Italy's Constellation of Small Satellites for the Mediterranean Basin Observation (COSMO SkyMed) and Canada's Radarsat-2), as well as airborne radar systems (NASA's Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR), an instrument mounted to a modified business jet). Combining these various data sets offers scientists the chance to build up a relatively dense time series of the evolution of fault slip and aseismic creep, enabling them to better understand fault friction and behavior.

New SAR Acquisition Mode

The images that Sentinel-1 acquired over Napa Valley in August 2014 happened to be in "StripMap" mode, in which the satellite scans the ground in a single strip, generating one long image 80 kilometers wide. StripMap is similar to the default high-resolution mode used by most previous radar satellites. However, for Sentinel-1, the default radar acquisitions over continental areas will be in a novel mode, in which the craft steers its radar beam, taking three smaller and slightly overlapping images that will be stitched together into one wider image [*Salvi et al.*, 2012].

The most significant advantage of this new scanning mode, called Terrain Observation by Progressive Scans (TOPS), is that a 250-kilometer-wide image can be acquired at high spatial resolution. This wider swath means that Sentinel-1A is the first radar satellite that can revisit any point on Earth's land surface every 12 days.

> Sentinel-1A's wide swath makes it the first radar satellite that can revisit any point on Earth's land surface every 12 days.

On the other hand, TOPS introduces a new challenge: The wealth of individual images requires very different processing and data management methods than the old SAR acquisition types with a single image per product. An active research topic for the community of scientists involved with analyzing SAR/InSAR data involves developing strategies for optimally handling TOPS data. These strategies include creating new software processing tools for the radar and using large hardware servers to be able to store the anticipated huge volumes of data that will be collected over the 20-year lifetime of the program.

Open Data and Other Future Aspirations

The science team plans to be ready by mid-2015 to process the vast quantities of data that Sentinel-1A will collect. In 2016, Sentinel-1A will be joined by a second, identical satellite, Sentinel-1B, completing the constellation. The added satellite will double the amount of data collected and halve the revisit time to 6 days, improving the quality of data and capturing with greater ease rapidly changing events as they unfold. The mission will have a long duration to ensure data consistency and continuity, with future launches planned as each satellite fails or runs out of fuel to extend the time series to at least 20 years.

For the first time for any radar mission, Sentinel-1 data will be freely available to the whole community. Specifically, the UK Natural Environment Research Council's Centre for the Observation and Modelling of Earthquakes, Volcanoes and Tectonics (COMET; http://comet.nerc.ac.uk) plans to provide the

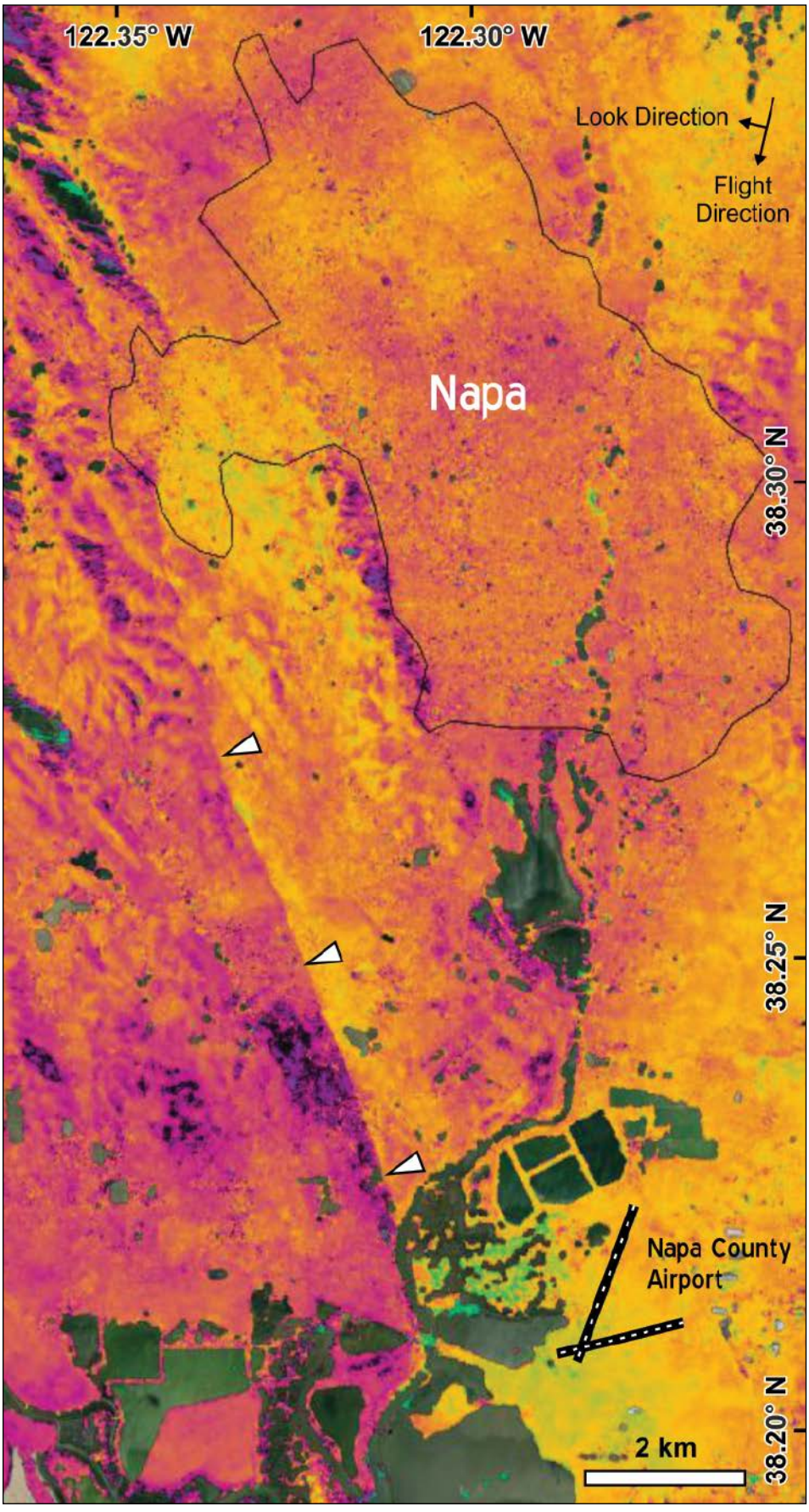


Fig. 3. Postseismic interferogram built by comparing scans from 31 August 2014 with those from 12 September 2014, showing shallow afterslip (aseismic creep) of about 2 centimeters along the fault (indicated by the sharp trace separating pink from yellow, marked with white triangles). The black outline denotes the area of Napa City. The interferometric results can be downloaded from http://insarap.org.

research community with the processed InSAR results from Sentinel-1 for all the tectonic and volcanic regions of the planet. This data availability will greatly widen the group of users and scientists who will be able to exploit these previously restricted data sets.

When the Sentinel-1 constellation is fully operational, the average time delay between an earthquake and the first post-event acquisition will be just 1.5 days. The team will post interferograms and standard analyses of the InSAR data for earthquakes online in near-real time, providing robust information for scientists and responders in the field.

At the same time, the regular acquisitions of data will quickly build into large stacks for each track as the mission progresses. COMET will use these to produce estimates of average surface velocities and time-dependent motions. These estimates can help scientists assess the slow accumulation of interseismic strain around locked faults and also probe the fluid-like behavior deeper within the crust.

By 2034, there will be a 20-year archive of radar data from the Sentinel-1 program. We can expect that this archive will fundamentally change the way we view our planet, monitor surface processes, and analyze the evolution of geohazards over time.

Acknowledgments

We gratefully acknowledge the European Space Agency's (ESA) Copernicus program and also funding from ESA's Scientific Exploitation of Operational Missions (SEOM) program under contract 4000110680/14/I-BG. The interferograms presented are a derived work of Copernicus data, subject to the ESA use and distribution conditions.

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Highlights of the 2014 AGU Fall Meeting

Working Together to Advance the Earth and Space Sciences

© Gary Wagner Photos

Carol Finn (left), now AGU past president, talks with Robin Chase (center), founder and former CEO of Zipcar, and Wendy Schmidt (right), president of the Schmidt Family Foundation, during the AGU Presidential Forum.

For nearly 5 decades, AGU's Fall Meeting has been an experience like no other, with luminaries and students engaging in deep discussions during a poster presentation, old friends grabbing lunch at their favorite watering hole between sessions, exhibitors talking about the latest research tools and services as attendees wander through the Exhibit Hall, and colleagues gathering for impromptu collaborations around a laptop on the floor in the hallways of the Moscone Center.

The passionate, innovative, and welcoming community of nearly 23,000 scientists who gathered for the 2014 meeting marked a continuation of this legacy. As you shared your knowledge, discussed solutions, and developed new collaborations, you embodied AGU's mission of "Earth and space science for the benefit of humanity."

For a week, the Fall Meeting offered an extensive schedule of scientific presentations, skill-building workshops, and networking and social events.

Celebrating Groundbreaking Research

The scientific program exceeded all previous records, with more than 23,000 abstracts submitted.

Nearly 50 town hall meetings on topics such as scientific drilling in polar regions and advancing understanding, monitoring, and prediction of drought also took place, and in addition to more than 20 named lectures, the meeting featured 4 Union lectures:

- The Union Frontiers of Geophysics Lecture, given by Jeffrey Sachs, director of The Earth Institute, Quetelet Professor of Sustainable Development, and professor of health policy and management at Columbia University
- The Union Agency Lecture, given by U.S. Secretary of the Interior Sally Jewell
- "Building Resilient Communities," given by Kathryn Sullivan, National Oceanic and Atmospheric Administration administrator and under secretary of commerce for oceans and atmosphere

© Gary Wagner Photos

Secretary of the Interior Sally Jewell welcomes questions during the Union Agency Lecture.

- A special Presidential Forum, which featured presentations by Robin Chase, founder and former CEO of Zipcar, and Wendy Schmidt, president of the Schmidt Family Foundation.

AGU's commitment to fostering interdisciplinary and cross-disciplinary research was also clear. The SWIRL program, which organizes select sessions from the various

sections into themes, made its third appearance at this meeting. It was also joined by a new effort: sessions jointly organized and planned by two or more sections and/or focus groups.

Fostering Professional Development

The Fall Meeting offered you opportunities to improve your professional skills in a variety of areas through more than 30 workshops, ranging from "Getting on the Tenure Track and Succeeding" to "Science Storytelling Through Video." Skill-building programs for science educators were widely available and prominently showcased, with the return of the popular Geophysical Information for Teachers (GIFT) workshops, as well as the addition of new workshops, such as the session on "Integrating Serious Gaming into Climate Change Education." There was also an extensive program and numerous networking opportunities in the Career Center, which catered to all types of audiences, including job seekers and students.

Showcasing Science for the Public

As a part of its commitment to science and society, each year we host public programming on the Sunday prior to the meeting. The 2014 Pubic Lecture featured scientists from the Mars Atmosphere and Volatile Evolution (MAVEN) mission, which launched in November 2013 and arrived at Mars in October 2014.

After the lecture, attendees could visit Exploration Station, the family-friendly event that features hands-on activities designed to teach children about the wonder and excitement of Earth and space science. Exploration Station experienced record-setting participation, with more than 800 attendees.

Making Connections and Highlighting the Best of the Best

We were also excited to be able to offer access to a comprehensive and inspiring Exhibit Hall—the biggest in Fall Meeting history, with more than 280 exhibitors from 25 countries. For the second year in a row, the Ice Breaker reception was held in conjunction with the opening of the Exhibit Hall on Monday evening, and judging by the crowd of people gathered at the door as I was cutting the ceremonial ribbon, it was a great success.

Of course, the Fall Meeting would not be complete without chances to chat with and meet your friends and colleagues, so AGU continued to provide a full schedule of social and networking events throughout the week. AGU also stopped to recognize the outstanding achievements of 89 of our colleagues during the AGU Honors Ceremony, which included a reception and banquet.

Jeffrey Sachs, director of the Earth Institute at Columbia University, talks about the unique role geoscientists can play in reducing climate threats. Kathryn Sullivan (top right), under secretary of commerce for Oceans and Atmosphere and National Oceanic and Atmospheric administrator, offers insights on how to build resilient cities.

Expanding Virtual Options

To help those of you who could not attend the meeting in person still be engaged in all of the great meeting programming, AGU continued to offer the extensive Virtual Options program. Hundreds of presentations and lectures were live-streamed, and all of the sessions that were live-streamed—plus several additional sessions—have been made available as video on demand (see https://virtualoptions.agu.org/).

AGU also continued to offer presenters the opportunity to upload an electronic copy of their posters to the Fall Meeting website. Currently, more than 2000 posters are available. As a new feature, video presentations of certain ePosters are now available.

Making Headlines

With more than 140 journalists in attendance at the meeting and even more tuning in online for live broadcasts of press conferences and streaming of sessions, news from the Fall Meeting was carried in newspapers and blogs and on television, radio stations, and websites around the world.

The growing importance of social media in science communications was also clearly felt during the meeting. #AGU14 trended at multiple points throughout the week, and the overall Twitter reach for the hashtag totaled more than 72 million.

The best Fall Meeting news stories and social media conversations are available on (http://fallmeeting.agu.org/2014/fmbuzz/), the Fall Meeting's "news and more" site.

Ensuring a Successful Fall Meeting

I want to recognize the efforts of everyone who was involved in making the 2014 Fall Meeting a success because without all of you, this important event would not be possible.

Thank you to those who submitted session proposals and abstracts. Your work is the backbone of the meeting, and your willingness to share your discoveries speaks to the sense of community that exists within the Earth and space science field.

Thank you to the Fall Meeting Program Committee, whose members worked tirelessly to organize all the amazing content into an event that would exceed all of our expectations and challenge us to think about our science in new and exciting ways.

And thank you to everyone who attended the meeting. Your enthusiasm permeated the halls of the Moscone Center, continuing the Fall Meeting's legacy of excellence, collaboration, and innovation.

I hope to see you again for the 48th Annual AGU Fall Meeting—Monday, 14 December through Friday, 18 December 2015!

By **Carol Finn,** *Past President, American Geophysical Union; email: pastpresident@agu.org*

2014 Fall Meeting by the Numbers

56,847 = Tweets sent from 12 through 18 December by 28,073 contributors using #AGU14
24,920 = People registered
23,224 = Abstracts submitted
8276 = Number of attendees who chose the program book opt-out option during registration
7577 = Number of live views of sessions and special lectures during the meeting via AGU's Virtual Options
3202 = Student presentations judged for the Outstanding Student Paper Award
2323 = Number of registrants who made $5 gifts to support Student Travel Grants when they registered
2227 = Members who judged student presentations
2000 = Dollars raised by attendees for programs such as the Mass Media Fellowship by spinning the AGU Fun(d) Wheel at the AGU Marketplace Booth within the Moscone South Exhibit Hall
1500 = Square footage of the AGU Marketplace Booth in the Exhibit Hall
975 = People who attended the family-friendly Exploration Station
855 = Items sold at the AGU Marketplace and Gift Shop
829 = AGU membership renewals processed
320 = Gigabytes of video recorded by AGU videographer Derek Sollosi
318 = Student contest T-shirts sold at the AGU Marketplace and Gift Shop (all profits support future Student Travel Grants)
304 = Signatures gathered by six student volunteers for a petition supporting travel to scientific conferences for government scientists and increased federal funding for science
300 = Women who attended the Networking Reception for Early-Career Female Scientists and Students
286 = Exhibitors registered
230 = AGU editors and associate editors honored at the Editors' Evening
191 = Student and Berkner Travel Grants used to support attendance at the meeting
142 = Student volunteers who helped at various events in exchange for a complimentary registration
124 = Students who attended the inaugural Student & Early Career Scientist Conference
113 = People who attended the inaugural Diversity Reception
102 = Remote viewing sites where members participated in the virtual offerings
101 = Number of countries represented by international attendees
89 = Honorees recognized
84 = AGU staff in attendance
52 = Number of geoscience professionals who participated at the Career Opportunities Networking Luncheon
48 = Town Halls held
36 = Miles walked by AGU Public Affairs director Lexi Shultz, as measured by her pedometer
22 = Sharing Science events held
20 = Union Sessions held
19 = Press conferences held
11 = Age (in years) of the youngest Bright Students Training as Research Scientists (Bright STaRS) participant who showcased research in the poster hall
10 = Students in the science communication program at University of California, Santa Cruz, who contributed to the *GeoSpace* blog
7 = Number of geoscience professional showcase exhibitors
Priceless = The look on the face of a Cub Scout who's just earned a Geology Belt Loop at Exploration Station

By **Pranoti M. Asher,** *Manager, Education and Public Outreach, AGU; Email: pasher@agu.org; with many contributions from AGU staff*

AGU Board and Council Assess 2014 and Set the Stage for 2015

The AGU Board of Directors and Council both met the weekend before the 2014 Fall Meeting, marking the end of the leadership term for those rotating off the Board and Council and beginning the orientation of their successors.

In her final Council presentation, AGU president Carol Finn reflected on lessons learned about managing a changing organization, the importance of involving AGU's members and inviting students and early-career members to the table, the benefits of communicating often and in many ways, and her confidence in AGU's decision-making and governance processes.


© Gary Wagner Photos

Incoming AGU President Margaret Leinen passes the gavel to President-elect Eric Davidson. The president-elect chairs the AGU Council.

Incoming president Margaret Leinen spoke next, highlighting decisions made and plans under way to address issues raised by the Council in 2014. These include section and focus group funding, volunteer recognition, position statements, and the decision to convene the Council in person in September (rather than by teleconference) and again in March 2015, based on the success of the September meeting. She later passed a symbolic gavel of leadership to incoming AGU president-elect Eric Davidson, who will chair the Council's 2015–2016 term while Leinen chairs the Board.

The Board confirmed that AGU's financial position is strong, closing 2014 with a budget that is on track and a healthy balance sheet. The Board then approved a 2015 budget and operating plan based on principles set in September 2014: a balanced budget and the continuation of strategic initiatives that deliver on the goals articulated in the strategic plan. These initiatives seek to enhance and expand publications and meetings, better support scientists at all career stages, improve volunteer engagement, better serve international members, create greater public awareness of Earth and space sciences and their impact, and integrate content and build community through a cohesive digital strategy. The Board also participated in an exercise to inform the work of the Affiliation and Engagement Task Force and heard an update on plans to expand AGU's development program.

The work of the AGU Council was framed by rich discussions of the outcomes and implications of the Scientific Trends Task Force; the findings of the strategic review of AGU meetings; a report from the Fellows Program Review Task Force; an annual review of AGU's Honors Program; and a summary of best practices identified by leaders of AGU sections, focus groups, committees, and task forces. The Council passed a motion to amend the AGU Fellows selection criteria to encourage diversity of gender, geography, and interdisciplinary science in nominations and selections and to endorse the development of a concept for a "College of Fellows" program for Council review.

Both groups heard updates on AGU's accomplishments and health from Executive Director/CEO Christine McEntee and CFO Mark Hernick and received annual reports from the sections and focus groups and biannual reports from current committees and task forces.

By **Dana D. Rehm,** *Director, Marketing, Communications and Engagement, AGU; email: drehm@agu.org; and* **Cheryl Enderlein,** *Assistant Director, Volunteer and Leadership Services, AGU*

89 Geophysicists Honored at a Gala Tribute

© Gary Wagner Photos

Hiroo Kanamori, emeritus professor at the California Institute of Technology, received AGU's highest honor, the William Bowie Medal.

The 2014 Honors Tribute held on 17 December celebrated 89 AGU geophysicists for their breakthrough achievements, outstanding contributions, and service to the Earth and space science community. Through their perseverance, creativity, and diligence, these scientists have enabled the community to push the boundaries of scientific knowledge, opening up endless new possibilities for exploration. Their work enriches and improves the quality of people's lives by advancing, communicating, and inspiring science for a sustainable future.

Union Awardees and Prize

AGU Executive Director/CEO Chris McEntee began the celebration by presenting Union Awards to 15 honorees for their contributions to research, transformative work in educating students and the public, outstanding achievements in science journalism, and engagement with a broader audience on scientific issues of critical importance. These award and prize recipients were celebrated for their passion for research, generous collaborations with colleagues, and dedication to their institutions and students.

This year, for the first time, AGU presented Ambassador Awards to five honorees in recognition of their outstanding contributions in the areas of societal impact, service to the Earth and space community, scientific leadership, and promotion of talent and the career pool. AGU also presented the Climate Communication Prize, supported by a generous grant from Nature's Own. The prize recognizes an AGU member-scientist for effective promotion of general scientific literacy as it relates to climate change and for efforts to foster respect for and understanding of science-based values.

Union Fellows

Last year, 62 esteemed members became AGU Fellows. Margaret Leinen, then AGU president-elect and now AGU president, presented the honors to these individuals, whose visionary leadership and scientific excellence has fundamentally advanced research in their respective fields.

This is an elite class, with only one-tenth of 1% of the AGU membership elected in any given year. The AGU Fellows are a highly influential group at the very peak of their prolific professional careers. The breadth of their research interests and the scope of their contributions are remarkable. The class chosen in 2014 is one of the most scientifically diverse, with research interests spanning AGU's sections and focus groups.

Union Medalists

In the final highlight of the evening's celebration, AGU's then president and now most recent past president Carol Finn presented 14 recipients with AGU medals. AGU medals are among the most esteemed in all of the geophysics and the highest honors bestowed by the Union. AGU medalists are pioneers and visionaries whose examples of dedication, professionalism, and generosity have guided students, opened up new fields of research, and led to valuable collaborations that push the boundaries of scientific knowledge. Their innovations and discoveries have changed the way we view the world around us, and their achievements have benefited humankind immeasurably.

This year's William Bowie Medal was given to Hiroo Kanamori, emeritus professor at California Institute of Technology, for his outstanding contribution to geophysics, earthquake physics, and hazard mitigation. Quoting from his citation, "Hiroo Kanamori is a true gentleman and always most friendly to people, regardless of their gender, ethnicity, or race. Not only a great number of students but also the whole geophysical community have profoundly benefited from his work."

"Together with the late Kei Aki," the citation continues, Kanamori is a "'made in Japan and perfected in America' giant star, who will remain shining brightly in the history of seismology."

The James B. Macelwane Medals were given to five outstanding young scientists who have made significant contributions to the geophysical sciences. Nine other medals were presented to AGU scientists who are giants in their fields and on whose shoulders the next generation of scientists will stand.

A Festive Evening

The Honors Tribute continues to create an ever-expanding community through the celebration of our honorees' achievements. Welcoming more than 1000 guests, seasoned professionals and students, at the Honors Ceremony, AGU celebrated its goals of expanding public engagement.

Before the event, colleagues, friends, and relatives of honorees congregated at a champagne reception. They then proceeded to a formal Honors Banquet, which closed with lively music and dancing.

Finn expressed her sincere gratitude, not only to individual members but also to the relatives and friends who stand behind the awardees being recognized. She also thanked AGU members who served on the awards, fellows, prize, and medal selection committees and who gave their time to choose these honorees.

The nomination period is now open for awards, medals, prizes, and Fellows. We urge all of you to nominate your colleagues who are most deserving of AGU honors (visit http://bit.ly/AGUHonors). As you think of these individuals, please pay particular attention to underrepresented groups. We look forward to 2015 and to all your valuable support and commitment to AGU's Honors Program.

By **Beth Paredes,** *Assistant Director, Executive Operations and Awards Administration, AGU: email: eparedes@agu.org*

Scouts, Students, and Faculty Benefit from Education Programs

New activities at the 2014 Fall Meeting included a program for Boy Scouts and Girl Scouts at Exploration Station and new workshops on program evaluation and using serious games in the classroom, among other topics. In addition, the Bright Students Training as Research Scientists (Bright STaRS) program reached new milestones, with a record number of abstracts submitted (51) and its first student participation from South America.

The Fall Meeting kicked off with the Public Lecture on NASA's MAVEN Mission to Mars (see the full lecture at http://bit.ly/VOMAVEN). Panelists Bruce Jakosky, Roger Yelle, and Sandra Cauffman engaged an audience of more than 250 in a discussion of the MAVEN mission's search to discover how the atmosphere of Mars has changed over time. Panelists also shared insights into the secrets of running such a complex mission.

After the Public Lecture, local students and their families went next door to Exploration Station, where enthusiastic AGU members led them in hands-on activities on volcanology, space science, hydrology, the electromagnetic spectrum, and more. For the first time, Boy Scouts and Girl Scouts engaged in activities at Exploration Station booths that were framed around completing specific badge requirements, and 90 scouts participated. Overall, 975 people visited Exploration Station, a record number for this event.

On 15 December, a weeklong suite of education workshops began. New workshops on improving program evaluation, broadening participation in the geosciences, and integrating serious gaming into the classroom engaged attendees in hands-on activities, interaction, and small-group discussions. The Bright STaRS program brought middle and high school students from Vermont, Colorado, California, Chile, and Hong Kong to the meeting and set a new record, with 51 abstracts. The youngest participant was a sixth grader from Colorado who, in the Bright STaRS session on 18 December, showcased his research on using unmanned aircrafts to observe glaciers and sea ice. All of the 90 student participants enjoyed a special luncheon along with their mentors, and chaperones, along with AGU honorees, and AGU leaders.

Activities through AGU's Education Department are not restricted to those who teach. Education and public outreach is a key component of any well-rounded scientist's work, and each year at Fall Meeting, AGU offers its members many tools to increase their education and outreach skills. Visit our website (http://education.agu.org/) to see resources from the 2014 meeting and offerings for the 2015 Fall Meeting.

By **Bethany Adamec,** *Coordinator, Education and Public Outreach, AGU; email: bhadamec@agu.org; and* **Pranoti M. Asher,** *Manager, Education and Public Outreach, AGU*

Virtual Programs Give Everyone Access to the 2014 Fall Meeting

AGU extended the reach of its 2014 Fall Meeting well beyond San Francisco by live streaming events, uploading ePosters, and engaging numerous remote viewing sites around the world. Thousands of scientists and members of the general public in 65 countries watched video recordings of Union lectures, named lectures, and oral presentations. In all, AGU made more than 700 presentations available through live streaming.

Some of the most popular presentations included the Public Lecture on the Mars Atmosphere and Volatile Evolution (MAVEN) mission, a session on the European Space Agency's Rosetta mission, and keynote speeches by Earth Institute director Jeffrey Sachs, Secretary of the Interior Sally Jewell, National Oceanic and Atmospheric Administration director and under secretary of Commerce for Oceans and Atmosphere Kathryn Sullivan, Buzzcar CEO Robin Chase, and Wendy Schmidt, president of the Schmidt Family Foundation.

In addition, 102 institutions across the globe registered as remote viewing sites and gathered their scientists and members to collectively view the virtual content. These institutions included government agencies, research institutions, companies, museums, universities, colleges, and interested public groups.

ePosters also played a critical role in this year's virtual program, with a total of 2055 uploaded. The electronic versions of the posters could be accessed by attendees and non-attendees alike. Furthermore, an on-demand poster presentation pilot was launched, in which scientists were recorded while presenting their ePosters. These recordings are available on the Virtual Options site with the other recorded content. In 2015, we hope to expand this program significantly and afford more scientists the opportunity to share their research.

AGU will continue to look for ways to further develop and enhance its virtual options for both onsite and remote attendees. As we lay the groundwork for the 2015 meeting, we hope to hear from our members regarding how we can improve the virtual experience.

View our website (https://virtualoptions.agu.org) for additional information on AGU's Virtual Options program. Feedback can be sent to virtualoptions@agu.org.

By **Virgil Brown,** *Project Manager, AGU; email: virtualoptions@agu.org*

See Eos.org for more highlights from the 2014 AGU Fall Meeting

Thriving Earth Exchange Hosts Community Science in Action Events

AGU's Thriving Earth Exchange (TEX; http://thrivingearthexchange.org/) builds collaborative relationships between community leaders, scientists, and sponsors and helps them design and implement local solutions. TEX is driven by local communities and their real-world issues with natural hazards, natural resources, and climate change.

TEX held three events at the 2014 Fall Meeting. Together, they provided participants an opportunity to learn, practice, and be inspired by community science.

Community Science in Organizations

TEX kicked off its programming at the 2014 Fall Meeting with a session on 16 December on the theory of community science within a range of organizations (for the virtual telecast, see http://bit.ly/VOTEX).

Speakers included Roger Pulwarty, of the National Oceanic and Atmospheric Administration; Ramakrishna Nemani, of NASA; Bob Gough, of the Intertribal Council on Utility Policy; and Julie Maldonado, of the U.S. Global Change Research Program. Addressing the challenges for scientists working in an unfamiliar context, Gough joked that community science with indigenous communities was "something anyone can do if they are willing to spend three generations learning the culture." Gough also emphasized patience, something all the panelists agreed was essential.

Another key message was that scientists need to work with community members to define the problem and imagine solutions, rather than coming in with a predefined solution. One example highlighted was the case of Rawalpindi, Pakistan, which is adapting to more frequent flooding events associated with climate change by treating sewage. While it doesn't prevent flooding, sewage treatment prevents the negative health impacts associated with flooding, which residents identified as their primary concern.

A Focus on Neighborhood Resilience

At a hands-on TEX workshop on 18 December, San Francisco County Director of Neighborhood Resilience Daniel Homsey offered advice on how to begin a community discussion that could lead to community science projects. He proposed that community members and scientists start with a satellite view of the neighborhood to get residents thinking about what kind of actions they could take to ensure that their community could maintain power, water supplies, and communication if they were cut off from the outside world.

This method of planning is important because it gets people working together, integrates diverse viewpoints, and situates scientists and their knowledge as allies and partners rather than outside experts. It also introduces the concept of risk into the process of finding solutions, which is novel and potentially more effective in bringing about change and empowering communities. People interested in using this approach in their own community can find more information at San Francisco's Neighborhood Empowerment Network website (http://resilientville.org).

Natasha Udu-gama

Session participants ponder the "Resilientville" concept through an exercise where they strategize on how to maintain power, water supplies, and communication if their community is cut off from the outside world.

Personal Stories from Scientists and Community Members

At an 18 December networking reception, attendees heard firsthand, through 5-minute "lightning" talks, about the experiences of scientists and community members and their passion for developing community science projects.

Scott Dobler, of Western Kentucky University's Mesonet, a network of automated meteorological stations, talked about the value of codesigning tools with water managers, a process that has led to the development of tools that are quite different from what the scientists imagined.

Linda Smith, of Filters for Families, a nonprofit based in Colorado, talked about how much water on the Pine Ridge Reservation in South Dakota is unsafe or untested. She discussed how she works with cancer survivors to test and treat the water.

LaShonn Billingsley, a Denver community leader in the resident-led research cooperative Taking Neighborhood Health to Heart, said communities want scientists as partners because "we don't even know what we don't know. We need scientific input, and scientists have to walk the line between deferring to community members and dominating the discussion, and vice versa," she said.

Karim-Aly Kassam, who has been working with villages in the Pamir Mountains of Afghanistan and Tajikistan to help them adapt to a changing climate, also presented a lightning talk at TEX's networking reception. Kassam and his team of researchers at Cornell University have been studying the region for more than 10 years. He suggested using the latest climate science to help adapt and update ecological calendars in the Pamir Mountains, because an approach that respects traditional practices is more likely to be successful than one that seeks to replace them. As for working in such a challenging place, Kassam said, "It is precisely because the challenges are so large in this region that we are compelled to work there.

From Talk to Action

Currently, the Pamir Mountains discussion is hosted on Massachusetts Institute of Technology's Climate Colab (http://bit.ly/PamirColab), which offers a space for community members and experts to create, analyze, and select actionable proposals to address climate change. Anyone can submit an idea by selecting the "Create Proposal" button, or people can participate in ongoing discussions around existing ideas or the general concept itself. All AGU members are invited to explore the concept on Climate Colab.

The networking reception was a huge success and reflected the kind of connections TEX would like to foster online.

Thank You

TEX extends a hearty thank you to all of those who supported our Fall Meeting events in San Francisco. All of our events were a great success, due, in large part, to the talented people who spoke and to the passionate people who attended.

By **Natasha Udu-gama,** *Director of Community Partnerships, Science, AGU; email: nudu-gama@agu.org; and* **Raj Pandya,** *Program Director, Science, AGU*

Colin Phillips

The North Fork Virgin River in Zion Canyon, Utah.

Bank Materials Strongly Influence River Valley Evolution

River valleys come in many different shapes and sizes, from the narrow gorges of Utah's canyon country to the broad coastal plains of Texas. These valleys form as rivers erode Earth's surface, and their shapes alone result from the interplay of local geology and global forces. Geologists have long sought to use valley shapes alone to reconstruct past changes in climate and tectonics on Earth and on other planets, but *Limaye and Lamb* provide new evidence that the importance of local geology should not be overlooked.

The researchers used a simple numerical model to explore the influence of river erosion on valley shape in the absence of major climate or tectonic shifts. They considered the pace at which a river erodes through sediment and bedrock laterally and vertically, and the initial distribution of both materials in the vicinity of the channel. They found that as rivers erode bedrock and deposit sediment, these bank materials help steer future patterns of channel migration, producing a wide range of valley morphologies.

The new results reveal that many types of river valleys—even deeply entrenched channels—can form under steady erosion rates and do not require rapid pulses of river downcutting due to uplift or sea level changes, as previously thought. The authors also found that when an abrupt geologic event does trigger rapid downcutting, it may not always leave a lasting imprint on valley morphology because subsequent erosion can wipe out the evidence.

All of these conclusions suggest that the intrinsic patterns of river migration, which can be influenced by the surrounding bank materials, should be considered when interpreting climate and tectonic histories from river valleys. (*Journal of Geophysical Research: Earth's Surface,* doi:10.1002/2013JF002997, 2014) **—Julia Rosen, Freelance Writer**

Mapping Seismic Activity in the Pamir Mountains

To better understand mountain building and the earthquake occurrence in a given region, it is important to know detailed information about the region's tectonics and deformation patterns. In the Pamir Mountains—which lie northwest of Tibet and extend across Afghanistan, China, Kyrgyzstan, Pakistan, and Tajikistan—researchers had only used data from the largest seismic events to characterize the underlying tectonic activity. *Schurr et al.* now go further to better understand the Pamir Mountains by studying lower-energy seismic activity in its more recent past.

The authors took 2 years of seismic data from temporarily and permanently installed instruments and geologic and remote sensing data from across the region to create a tectonic map describing deformation over the past 50 million years. The authors also employed a new three-dimensional velocity model to precisely locate the more than 6000 seismic events across Pamir; they were able to constrain the source mechanism for 132 of them.

The authors found significant north-south shortening and a westward increasing amount of east-west extension across the region, which they note can be explained by the collapse of the region's western margin and by lateral extrusion westward into the Tajik-Afghan depression. Such findings will be an important baseline for future research of the geologic evolution of the Pamir Mountain ranges. (*Tectonics*, doi:10.1002/2014TC003576, 2014) **—JoAnna Wendel, Staff Writer**

Bernd Schurr

Temporary seismological station near Rangkul, Tajikistan, on the eastern Pamir plateau.

What's Driving Titan's Atmosphere?

Titan, Saturn's largest moon, still holds many mysteries in its thick atmosphere despite a decade of observations from NASA's Cassini spacecraft. What spurs the growth of large chemical compounds high in the moon's ionosphere? Why is the chemistry so efficient at creating unsaturated and aromatic hydrocarbons?

To better explain Titan's variable upper atmosphere, *Westlake et al.* enlisted the Ion Beam Spectrometer (IBS) on Cassini's Plasma Spectrometer (CAPS) to measure the composition and concentration of large hydrocarbon ions. The researchers made use of data from a continuous flyby of the instrument; only partial flybys were available before that due to the mechanical sweeping of the instrument aperture. The flyby revealed vast chemical complexity in ion structure.

The team used data analysis and numerical models to isolate the key drivers for large hydrocarbon ion growth high in Titan's atmosphere. They that found ion-molecule reactions are responsible for the growth in Titan's heavy ions. Their research also shows that the heavy ions are created from acetylene and ethylene, which are each atmospheric building blocks. In turn, these large ions become a significant source of the massive hydrocarbons seen across the moon, including the middle and lower atmosphere, as well as the surface.

The authors call for laboratory tests that seek to reproduce reactions between these large hydrocarbons, as well as nitrogen-containing hydrocarbon ions, to help figure out exactly what's happening in this alien environment. (*Journal of Geophysical Research: Space Physics*, doi:10.1002/2014JA020208, 2014) **—Eric O. Betz, Freelance Writer**

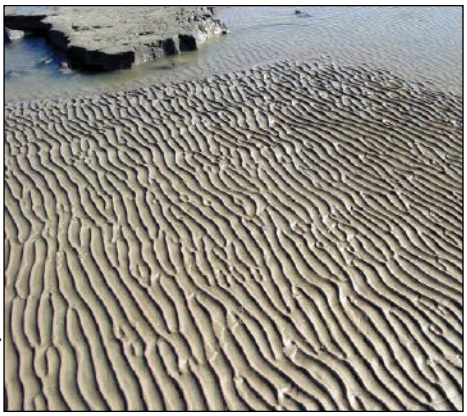
Wave Ripples Spaced by Flow Downstream of Ripple Peaks

The mesmerizing ripple patterns formed by waves and preserved in sedimentary rocks provide valuable environmental information because ripples develop in predictable ways. At equilibrium, they achieve a consistent ratio between the distance between ripple peaks (the wavelength) and the amplitude of the oscillating flow at the bed, which in turn depends on the wave size and water depth.

In a new study, *Nienhuis et al.* provide the first complete mechanistic explanation for this ideal ratio. Using wave tank experiments and flow modeling, the researchers found that the spacing between ripples depended on the size of the separation zone—the area downstream of a peak where flow is decoupled from the main current and forms a vortex. Their results show that the preferred ratio occurred when the separation zone reached just to the next peak, maximizing scouring in the trough and deposition on the crests and thus reinforcing the existing ripple pattern.

The researchers also investigated what happens to ripple patterns when environmental conditions change. They found that secondary crests formed on both flanks of existing ripples when waves got smaller, but that only one set—left or right—survived the transition. This finding is consistent with previous work. They show that this occurs because the favored crest acts as a speed bump, slowing flow over the main ripple in a way that preferentially scours the competing crest and preserves the corresponding crest on the next ripple.

For increasing wave sizes, the researchers' results help explain observed increases in ripple sinuosity. They propose that stronger flows can accelerate in the space between widely spaced peaks, scouring them and pushing them farther apart. Conversely, scouring is suppressed between closely spaced peaks, and they migrate closer together. This new insight will improve interpretations of ripples, including those without modern analogues and those on other planets. (*Journal of Geophysical Research: Earth's Surface*, doi:10.1002/2014JF003158, 2014) **—Julia Rosen, Freelance Writer**



Zoltán Sylvester

Wave-formed ripples on a beach at low tide at Sea Rim State Park in Texas. Scale bar is approximate due to perspective.

Mekong River Dams Could Bring Future Food Security Woes

Thomas B. Wild

A woman steers her fishing boat along a tributary of the Mekong River in Phnom Penh, Cambodia.

More than 60 million people depend on fish drawn from the Mekong River. The river—which flows from the Tibetan Plateau to the Vietnam Delta, passing through China, Myanmar, Thailand, Laos, and Cambodia—is crucial to the economies and livelihoods of millions. It's also a biodiversity hotspot, home to roughly 23,000 plant and animal species, some found nowhere else.

The Mekong River basin is also one of the most quickly developing watersheds in the world: There are at least 134 dams in various stages of planning and development on the lower stretches of the river alone. The potential for hydroelectric generation in countries affected by high rates of poverty is enticing, yet these gains could easily be lost if damming the river hurts the crucial fisheries.

Using a sediment flow model tuned for the Mekong River, *Wild and Loucks* found that, depending on how they are constructed and managed, dams in the Sre Pok, Se San, and Se Kong sub-basins of the Mekong could reduce sediment flows in these tributaries by anywhere from 40% to 80%. Sediment affects the river's physical behavior and shape, and nutrients sustain the downstream ecosystem.

Based on their calculations, the authors found that in most cases the amount of sediment trapped by the dams wouldn't be enough to significantly degrade their hydroelectric generation potential. The trapped sediment could be enough, however, to have serious consequences on downstream ecosystems.

The impetus to redesign the proposed dams to be more amenable to sediment flow or to budget for sediment management programs, the authors say, will thus come down to prioritizing long-term ecosystem health, food security, and biodiversity over short-term economic gains. (*Water Resources Research*, doi:10.1002/2014WR015457, 2014) **—Colin Schultz, Freelance Writer**

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Atmospheric Sciences

Aerosol Researcher in Atmospheric Processes and Chemistry at Princeton University

The Atmospheric and Oceanic Sciences Program at Princeton University in cooperation with NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) seeks a postdoctoral fellow to develop and apply satellite based dust emission parametrization to improve our understanding of dust effects on climate and air quality, with a particular focus on anthropogenic contribution. Topics of particular interest include: statistical methods of parameter estimation, analysis of satellite aerosol products, advancing numerical representation of chemical and optical properties of dust, modeling heterogeneous reactions on aerosol surface, modeling aerosol interactions with radiation and cloud properties. Personnel will join an active group at Princeton and GFDL conducting research to advance the fundamental understanding of atmospheric and land processes in governing climate variability and change (http://www.gfdl.noaa.gov/atmospheric-processes). We are seeking candidates with quantitative, interdisciplinary knowledge from subsets of fields including aerosol modeling, statistical analysis, and atmospheric chemistry. Experience analyzing large data sets and/or model output is also critical, as is model development experience. These are two-year positions (subject to renewal after the first year) based at GFDL in Princeton, New Jersey. Complete applications, including a CV, publication list, contact information for 3 references, who will be contacted automatically in order to solicit letters of recommendation, and a one-to-two page statement of research interests should be submitted by February 28, 2015 for full consideration, though evaluation will be ongoing. Applicants should apply online to http://jobs.princeton.edu, Requisition # 1400940. For additional information, please contact Paul Ginoux (paul.ginoux@noaa.gov). This position is subject to the University's background check policy. Princeton University is an equal opportunity employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, disability status, protected veteran status, or any other characteristic protected by law.

Biogeosciences

The Marine Science Institute (University of California, Santa Barbara) seeks a PhD level postdoctoral fellow to contribute to studies of coastal watersheds and fluxes into coastal waters associated with an on-going LTER project

(http://sbc.lternet.edu/). The position will involve analyses of hydrological and hydrochemical data and watershed-scale modeling of fluxes of solutes and particulates. Salary and benefits will depend on academic background and experience. 100% time appointment for one year from start date with possibility for second year renewal. Start date is negotiable, but is anticipated by April 2015. Electronic applications (including a full CV, description of research interests and names and addresses of three references) should be sent to: https://recruit.ap.ucsb.edu/apply/JPF00438. Application review will begin February 10, 2015 and continue until position is filled. The department is especially interested in candidates who can contribute to the diversity and excellence of the academic community. The University of California is an Equal Opportunity/Affirmative Action Employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, or any other characteristic protected by law including protected Veterans and individuals with disabilities.

Geochemistry

ASSISTANT or ASSOCIATE PROFESSOR IN PETROLEUM GEOCHEMISTRY CONOCOPHILLIPS SCHOOL OF GEOLOGY AND GEOPHYSICS THE UNIVERSITY OF OKLAHOMA

The University of Oklahoma invites applications for a tenure-track position in Petroleum Geochemistry at the assistant or associate professor level. The ConocoPhillips School of Geology and Geophysics has a long and distinguished history in Petroleum Geochemistry. We are seeking a creative, dynamic person to help us move forward into new and exciting areas of petroleum geochemical research, in particular, with respect to biomarker and stable isotope studies, and an effective teacher who will educate students so they can move into successful careers. The successful applicant will hold a Ph.D., have an academic background in the geosciences, develop an externally funded research program, and teach undergraduate courses in geology in addition to graduate-level courses in petroleum geochemistry.

The ConocoPhillips School of Geology and Geophysics is housed in the Sarkeys Energy Center. The Petroleum Geochemistry research facilities include wet chemistry laboratories for sample preparation and experimentation, all of which are equipped with fume hoods, chemical and solvent storage facilities, microbalances, ovens, water purification facilities, etc. Instrumentation is state of the art, including 7 gas chromatographs, gas chromatography/mass spectrometry instruments (a Thermo TSQ 8000 GC/MS/MS and two 5975 MSD systems), pyrolysis/gas chromatography instrumentation and high performance liquid chromatographic equipment. Our stable isotope laboratories are equipped with conventional facilities for the off-line combustion, isolation, and purification of gases for stable isotope analysis. The laboratory houses 5 stable isotope ratio mass spectrometers, including a Thermo DeltaV Plus, a MAT 252, a MAT 253, a Delta Plus XL and a Delta E for bulk and compound specific stable isotope analyses of organic and inorganic materials via dual inlet and in continuous flow modes using elemental analyzers and gas chromatographs interfaced to the instruments.

Review of applications will begin April 1, 2015. The search will continue until the position is filled. The anticipated start date for the position is August 15, 2015. Applicants are requested to submit a vita/resume, statement of research and teaching interests, and a list of five references who can be contacted, including telephone numbers, e-mail addresses, and mailing addresses. Questions or information requests should be addressed to the Chair of the Petroleum Geochemistry Search Committee, at (405) 325-3253 or ougeochemistrysearchchair@ou.edu. Applications should be addressed to Petroleum Geochemistry Search Committee, ConocoPhillips School of Geology and Geophysics, The University of Oklahoma, 100 East Boyd St., Room 710, Norman, OK 73019-1008.

The University of Oklahoma is an Affirmative Action, Equal Opportunity Employer. Women and minorities are encouraged to apply. Protected veterans and individuals with disabilities are encouraged to apply.

Research Associate in Stable Isotope Geochemistry Northern Illinois University

The Dept. of Geology and Environmental Geosciences at Northern Illinois University (NIU) invites applications for a research associate position in stable isotope geochemistry. The successful candidate will hold a full-time, non-tenure track appointment. We seek candidates with a research focus in isotope ratio mass spectrometry, the ability to operate and maintain analytical laboratory facilities supporting allied research across the university, and a desire to train students in analytical laboratory techniques. The capacity to collaboratively develop successful research proposals, publish research results, and successfully generate and conduct contracted analyses is essential to the position. Applicants must have a Ph.D. in geoscience or a related field; post-doctoral experience in a stable isotope laboratory is preferred. Applications including CV, statement of research experience, accomplishments and interests, and 3 letters of recommendation should be submitted electronically to the Dept. Chair, Mark P. Fischer, at mfischer@niu.edu. Screening of applications will begin March 1, 2015, and continues until the position is filled. For additional information about the position and the department, visit: www.niu.edu/geology. NIU is an AA/EEO institution that values diversity in its faculty, staff and students: we strongly encourage applications from diverse candidates, including women and minorities. A state-mandated pre-employment criminal background investigation is required.

Hydrology

Research Scientist in Fluvial Geomorphology. The U.S. Geological Survey's National Research Program (NRP) in Golden, Colorado, seeks to hire a Research Hydrologist to conduct research at the GS-12 or GS-13 grade level in the field of fluvial geomorphology. Candidates are expected to have a background in computational flow and sediment transport modeling as well as experience in field programs and remote sensing in riverine environments. Technical expertise in the physics of sediment transport, the mechanics and fluid dynamics of fluvial bank erosion, and the application of remote sensing are of particular interest. Research goals will focus on understanding and modeling the complex linkages between physical and biological processes in fluvial environments.

The primary responsibility of this position is to serve as a science leader who manages, coordinates, and actively participates in interdisciplinary science investigations. Candidates will identify and formulate relevant hypotheses, plan and design specific experimental strategies, and conduct field, laboratory, or numerical modeling investigations that solve critical problems faced by the nation and contribute to strategic priorities in USGS Water, Ecosystems, Global Change, and Natural Hazards Mission Areas (see http://www.usgs.gov/science_strategy/). This position requires strong collaborative skills and an enthusiasm for interdisciplinary science, as well as excellent written and verbal communication skills.

Effective Feb. 2, 2015, applications for this position will be accepted through the USAJOBS website at https://www.usajobs.gov (vacancy announcement ATL-2015-0118) through March 2, 2015. For additional information, contact the USGS Office of Human Resources at (303) 236-9589. U.S. citizenship is required. The U.S. Geological Survey is an Equal Opportunity Employer.

Ocean Sciences

Faculty Positions in the Department of Geological Oceanography, Xiamen University, China

Xiamen University (XMU) is located in the city of Xiamen, a "garden on the sea" in southern China, and has established a new Department of Geological Oceanography as part of the College of Ocean and Earth Sciences (http://coe.xmu.edu.cn/) that offers undergraduate and graduate degrees. The college is one of the top oceanographic programs in China. We are also building a 3600-ton (78 m) research vessel and a marine station for cutting-edge education and research in oceanography. XMU envisions the development of a world-class program in Geological Oceanography with focus on interdisciplinary studies of sediment processes and the sedimentary record in China's unique marginal seas.

POSITION ONE: HEAD OF DEPARTMENT

We are seeking applications from international scientists for the position of the head of the department. The search will remain open until the position is filled.

Duties:

1. Be in charge of the organization and general operation of the Geological Oceanography Department, formulating and implementing the strategy in the development of the Geological Oceanography discipline, and leading the Department towards growth and excellence.

2. Be responsible for building up a strong teaching and research team; and improving the overall academic level of the team in such efforts as devising a long-term team-building plan, recruiting high-level talents, cultivating young researchers and enhancing teamwork.

3. Explore new approach for talent cultivation and nurture talents with creative thinking.

Qualifications:

1. The applicant should hold a doctoral degree and a full professorship (or an equivalent position) in a prominent overseas university (or research institutes).

2. The candidate may be a specialist in any field related to geological oceanography, including (but not exclusively): sedimentology, sedimentary geochemistry, sediment transport, seismic stratigraphy, sediment acoustics, geotechnology, remote sensing, and numerical modeling of sediment transport and sedimentation.

3. Overseas experience (study or work) is required for this position. The candidate should have international perspective, strategic and creative thinking on the discipline development.

4. The candidate is expected to have distinguished academic credentials and international recogni-

tion for his/her achievements in research, scholarship and teaching.

5. The candidate should have a proven record of high-level administrative and leadership experience in a university setting, such as a department, a research institute or a laboratory, and will be able to take charge of teaching, research, team-building, discipline development, social services and administration.

Salary and Benefits:

1. Contract term: 4 years;

2. Annual Salary: 600K-900K RMB (1 US$~ 6.18 CYN) ;

3. Other benefits and issues can be negotiated.

POSITION TWO: FACULTY MEMBERS

We are seeking applications from international scientists for up to 15 faculty positions. The search will remain open until positions are filled.

Duties:

1. To teach undergraduate and graduate courses in a full English or bi-lingual capacity;

2. Be capable to obtain university and outside funding to establish their own research laboratories and facilities and build a research program of global interests;

3. Be able to participate in research cruises.

Qualifications:

1. Applicants must hold a doctoral degree in any field related to geological oceanography, and be a specialist in any field related to geological oceanography, including (but not exclusively): sedimentology, sedimentary geochemistry, sediment transport, seismic stratigraphy, sediment acoustics, geotechnology, remote sensing, and numerical modeling of sediment transport and sedimentation.

2. The applicants should be able to work across disciplinary boundaries, and have essential qualities for teamwork.

3. The rank of the appointment will be commensurate with the applicant's qualifications and experiences.

Salary and Benefits:

1. Contract term: 3 years for assistant professor; 5 years for associate professor and full professor.

2. The appointment system will be applied to the successful candidates. The selected candidates will receive the standard compensation for the faculty members of Xiamen University at the same rank.

HOW TO APPLY

Interested applicants should send a cover letter indicating the intent of the application (department head or faculty), his/her CV, contact information for 3-5 references, a statement of purpose that includes courses intended to teach and research interests and professional goals, and other supporting materials for the evaluation process to the Dean, Prof. Kejian Wang (wkjian@xmu.edu.cn).

Vacancy Announcement

Tenure Track Assistant Professor in Chemical Oceanography

December 2014

The School of Fisheries and Ocean Sciences (SFOS) at the University of Alaska Fairbanks (UAF) seeks applications from exceptional candidates for a tenure-track assistant professor position in chemical oceanography. Specialties of interest include ocean acidification, marine inorganic carbon chemistry, carbon biogeochemistry, carbon cycle-climate interactions, isotope biogeochemistry, and evaluation of the biological impact of ocean acidification. We are particularly interested in applicants whose research plan involves the new ice-capable, Global Class Research Vessel Sikuliaq.

UAF is Alaska's research university, North America's Arctic university and a world leader in Arctic and climate change research. The successful applicant will enjoy opportunities for collaboration within SFOS's vibrant high-latitude research program. The School offers a Minor in marine science, and MS and PhDs in oceanography and in marine biology. The UAF campus houses the Ocean Acidification Research Center (OARC), Alaska Stable Isotope Facility (ASIF), UAF's Advanced Instrumentation Laboratory (AIL), the Core Facility for Nucleic Acid Analysis, and is linked to the joint NOAA, UAF Kasitsna Bay Laboratory, Alaska SeaLife Center and the Seward Marine Center. SFOS has over 60 faculty based throughout Alaska and over 150 graduate students engaged in thesis research in Alaska waters, and throughout the world.

Applicants must hold a Ph.D. in oceanography or closely related discipline, and preferably have post-doctoral and teaching experience. The position requires research, education and service that support Alaska's ocean resources and the communities that rely on them. The successful candidate will be expected to teach core and/or develop specialty oceanography courses for the graduate and undergraduate academic programs, develop a vigorous externally-funded research program and mentor graduate students. Applicants must submit a statement of interest that outlines their qualifications for this position and includes a research plan, teaching statement, curriculum vitae, and names and contact information of at least three references. Applications must be submitted to Job Posting #0069942 at https:// www.uakjobs.com. For questions about the position, please contact Dr. Matthew Wooller, chair of the search committee, at mjwooller@alaska.edu. Review of applications will begin February 15th. For full consideration applications should be received by March 1st, 2015.

Solid Earth Geophysics

Director, Study of Environmental Arctic Change (SEARCH)

The Study of Environmental Arctic Change (SEARCH) is a system-scale, cross-disciplinary, long-term Arctic research effort to understand the nature, extent, and future development of the system-scale change presently seen in the Arctic. SEARCH-related projects are supported through US agencies, other national and international programs. The core mission of SEARCH is to provide a foundation of Arctic change science through collaboration with the research community, funding agencies, and other stakeholders. SEARCH aims for scientific understanding of Arctic environmental change to help society understand and respond to a rapidly changing Arctic.

Recently SEARCH completed a strategic planning process to define clear directions and priorities to move SEARCH to a fully implemented program. In addition to a new vision and mission, a set of 5-year science goals will advance knowledge of environmental Arctic change; details can be found at www.arcus.org/search-program. SEARCH was recently awarded a grant to undertake new activities related to the science goals.

We are seeking a Director, reporting to a SEARCH Science Steering Committee (SSC), to provide the program with management and scientific leadership to carry out its mission. As a public leader, the Director represents the best interests of SEARCH to diverse constituencies, including scientists, federal agencies, decision-makers, and stakeholders on the international, national, state and local level. The Director will be responsible for directing day-to-day activities. The Director will enable and coordinate several SEARCH committees in implementing the SEARCH mission.

Primary duties of the Director include management and evaluation of SEARCH program quality and effectiveness, including work with SEARCH "Action Teams" and various working groups; development of agency and stakeholder alliances in support of program goals; acquisition of external funding support; communication and coordination of program goals at the national and international level; work with the SSC on the development of a long-term strategy and associated implementation documents. We expect the successful candidate to seek external funding as opportunities arise in order to support SEARCH program goals.

The position will be located at the International Arctic Research Center (IARC) at the University of Alaska Fairbanks (UAF), and will require travel to national and international coordination meetings. The position comes with a competitive employee package and – depending on level of success and accomplishments during the first two years – the potential for flexible work arrangements.

Position requirements include research experience in a scientific field relevant to studies of Arctic change and a Ph.D. degree (or equivalent) in a relevant field with ten or more years of subsequent, relevant experience. A strong background in and understanding of interdisciplinary research are important attributes of the position. The various duties require strong communication skills, both interpersonal and oral/written. The desired candidate will have the flexibility necessary to provide direction in an evolving organization, with consensus-building skills to balance diverse perspectives while maintaining a sense of common purpose. This is a 12-month full-time contract, subject to annual renewal. Full details are available at www.uakjobs.com/applicants/Central?quickFind=86322. For more information about the position contact Hajo Eicken (heicken@alaska.edu, SEARCH SSC Chair) or Helen Wiggins (helen@arcus.org, ARCUS Director of Programs). Review of applications will begin March 15, 2015 and the position will remain open until a suitable candidate has been selected.

UAF is an Equal Opportunity Employer.

Geomagnetics Postdoctoral Researcher

Applications are now being accepted for a Postdoctoral Research Associate, funded through the University of Maryland College Park (UMCP) and the Center for Research and Exploration in Space Science and Technology (CRESST). The postdoc would work in the Planetary Geodynamics Laboratory of the NASA Goddard Space Flight Center (GSFC) in the area of geomagnetism, with emphasis on one of the following sub-areas: (1) numerical modeling of electric currents and the associated magnetic fields generated by oceanic flow processes, and the integration of these elements into the global geomagnetic field modeling; (2) determination of core flow utilizing surface geomagnetic observations and geomagnetic data assimilation. The postdoc will be expected to work closely with the core and crustal magnetic group at NASA/GSFC, but is also strongly encouraged to carry out independent research. The position is for one year, with possible extension depending on future funding and mutual agreement.

Applicants must have a Ph.D. degree (or expect to have the degree by the start of the appointment) in a related field of physics, geophysics and/or applied mathematics. Applicants are expected to have strong quantitative analysis and modeling skills – in addition to knowledge of geomagnetic fields, satellite or ground observatory data, geomagnetic field models, and core dynamics. Applicants also familiar with UNIX, Fortran, and parallel computing will be preferred.

Each applicant should send a Curriculum Vita, list of publications, statement of research interests, and contact information for three references to:

Geomagnetics
CRESST/UMCP
Mail Code 660.8, NASA/GSFC
Greenbelt, MD 20771, or
Via e-mail to virginia.c.peles@nasa.gov

Salary and benefits are highly competitive and commensurate with experience and qualifications.

Information regarding the Planetary Geodynamics Laboratory is found at:

http://science.gsfc.nasa.gov/solarsystem/planetarygeodynamics/

For information on CRESST and the UMCP's Department of Astronomy, please contact Tracy Huard (thuard@astro.umd.edu). The appointment may start as early as March 2015.

The University of Maryland is an Affirmative Action, Equal Opportunity Employer.

Women and minorities are encouraged to apply.

All applications received by March 2, 2015 will receive full consideration.

Interdisciplinary/Other

ASSISTANT PROFESSOR Neotectonics (tenure-track)

The Nevada Bureau of Mines and Geology (NBMG) at the University of Nevada, Reno seeks applicants with expertise in neotectonics and Quaternary geology. Nevada is one of the most exciting regions in the world to conduct research in the geosciences, particularly in the fields of neotectonics and geologic hazards. Position Responsibilities: The primary responsibilities of this position will be to develop programs in research and education in the field of neotectonics with emphasis on paleoseismic and earthquake hazard research in Nevada and the surrounding region. Research will focus on landscape evolution primarily as it relates to Quaternary faulting, utilizing innovative approaches, such as LiDAR, to conduct detailed geologic mapping and dating of Quaternary units and surfaces. The successful candidate will also be expected to contribute to the development of datasets and reports on Nevada's Quaternary faults and seismic activity, including periodic assessments and syntheses of hazards facing its major cities and infrastructure. Education will include teaching courses in the successful candidate's area of expertise, such as neotectonics, geologic hazards, and Quaternary geology in the Department of Geological Sciences and Engineering and supervising graduate students. Research and educational efforts will involve integrated multi-departmental (e.g. Nevada Seismological Laboratory) and multi-institutional efforts, with scientists from academia, industry, other institutions, and government labs. The successful candidate will be asked to communicate effectively with the public and community leaders regarding natural hazards in Nevada and coordinate mitigation and response efforts with local and federal emergency management agencies.

Qualifications: Applicants must have a doctorate in geology or a related geoscience field by the time of hire and a demonstrated record of research on topics related to neotectonics as indicated by dissertation research, industry experience, and/or peer-reviewed publications. Excellent communication skills, as demonstrated in written application materials; commitment to public service; potential for, or established record of publications; and ability to attract funding are essential. The successful candidate must also have the ability to develop and coordinate programs and work in teams to accomplish major goals.

Preference will be given to candidates with academic or industry experience in neotectonics. Expertise in paleoseismology (e.g. trenching), surficial processes, Quaternary dating techniques, LiDAR, and/or InSAR will be valued. Preference will be given to candidates who have demonstrated research productivity with publications in peer-reviewed literature. The successful candidate will compete for funding from a variety of sources, including federal agencies interested in fundamental and applied geoscience research (e.g., NSF, USGS, Department of Energy, and Bureau of Land Management) and industry. Therefore, preference will be given to candidates who explain achievable plans for funded research on Nevada-focused topics in neotectonics in their letters of interest. In addition, preference will be given to candidates who understand the role of NBMG as the state geological survey of Nevada and can articulate how NBMG can better serve stakeholders (citizens, government, and industry) on issues related to geologic hazards.

Salary and Date of Appointment: The position will be a tenure-track faculty appointment at the assistant professor level with an academic-year base salary that is competitive with other research universities. Starting date will be July 1, 2015 or shortly thereafter, depending on availability of the successful candidate.

To apply, please visit: https://www.unrsearch.com/postings/16813. Please submit a letter expressing your interest in the position and research plans; names, e-mail addresses, postal addresses, and telephone numbers of at least three references; a complete curriculum vitae; and electronic copies of up to three of your publications to http://jobs.unr.edu/. Application deadline is March 10, 2015. For further information about NBMG, please consult our website (http://www.nbmg.unr.edu).

The University of Nevada, Reno is committed to Equal Employment Opportunity/Affirmative Action in recruitment of its students and employees and does not discriminate on the basis of race, color, religion, sex, age, creed, national origin, veteran status, physical or mental disability, and sexual orientation. The University of Nevada employs only United States citizens and aliens lawfully authorized to work in the United States. Women and under-represented groups are encouraged to apply.

DIRECTOR NEW MEXICO BUREAU OF GEOLOGY & MINERAL RESOURCES

The New Mexico Bureau of Geology and Mineral Resources, Socorro, NM, is seeking a new director and state geologist. The bureau, with ~60 employees, is a prominent research and service division of New Mexico Tech and serves as the state geological survey, with a long-standing reputation for excellence in research, service, and outreach. Our mission includes research on the geologic framework of the state, with an emphasis on applied geoscience evaluation of water and energy resources. The bureau works closely with the university academic divisions as well as many state agencies. Full details of the position and information regarding application procedures may be found at http://geoinfo.nmt.edu/DirectorSearch and at www.nmt.edu/hr-jobs-at-nmt. For more information about the application process, contact JoAnn Salome in Human Resources at 575-835-5955 (JSalome@admin.nmt.edu). For more information about the position itself, contact Warren Ostergren, search committee chair, at 575-835-5363 (warreno@nmt.edu).

Faculty Position in Cryosphere Science in the Department of Earth & Environmental Sciences and the Lamont-Doherty Earth Observatory of Columbia University

The Department of Earth and Environmental Sciences (DEES) of Columbia University invites applications for an open-rank faculty position in cryosphere science. Appointment can be at any rank from tenure-track assistant professor to tenured full professor, though there is a preference for junior applicants.

We welcome applications from outstanding scientists who study aspects of the cryosphere that will broaden our research and teaching portfolio. Research interests include, but are not limited to: glacier or ice sheet dynamics, cryosphere response to climate change, ice-ocean interaction, climate-ice sheet modeling and interaction with the solid Earth, cryosphere biology and biogeochemistry, and/or subglacial hydrologic systems.

The successful applicant is expected to demonstrate or develop collaborative, interdisciplinary research programs addressing problems of global significance, and demonstrate strong teaching abilities at both the undergraduate and graduate levels.

Applicants should submit a cover letter, CV, statements of teaching and of research interests, and a list of 5 references using our online site at:

https://academicjobs.columbia.edu/applicants/Central?quickFind=60352

Review of applications will begin 01 March 2015 and continue until the position is filled.

Columbia University is an Equal Opportunity/Affirmative Action employer --Race/Gender/Disability/Veteran.

GDL Foundation Fellowships in Structure and Diagenesis

The GDL Foundation supports study and research of chemical and mechanical interactions, structural diagenesis, in sedimentary basins. Practical applications are of particular interest.

We are currently seeking applications from M.S. and Ph.D. candidates, post-doctoral researchers, and scientists for fellowships, up to $10,000, based on specific proposals for research and participation in meetings and conferences to share results.

Submit applications (available at: www.gdlfoundation.org) by April 1, 2015.

Physical Scientist in NOAA's Climate Program Office

The Climate Program Office (CPO) of the National Oceanic and Atmospheric Administration (NOAA) Office of Oceanic and Atmospheric Research (OAR) is seeking qualified individuals to oversee the CPO's Arctic Research Program.

The incumbent will provide guidance and mission leadership, management oversight and direction in overall day-to day management of CPO's Arctic Research Program; provide strategic leadership for OAR's

Arctic research activities; and contribute leadership towards NOAA's Arctic Science enterprise in collaboration with NOAA senior officials including the NOAA Arctic Advisor and NOAA Chief Research Scientist. S/he will also contribute to, or develop, strategic vision and other planning and budget documents and presentations to guide programs; represent the program and NOAA at intra-and inter-agency international meetings, including a potential leadership role in the Interagency Arctic Research Policy Committee observations group; attend scientific and programmatic meetings nationally or internationally; develop, maintain and/or advance the creation of new productive partnerships within and external to NOAA; propose defend and manage the program budget, administer financial awards, develop Announcements of Opportunities and monitor project performance; ensure effective timely and economical accomplishments of program objectives; and author scientific and technical papers and posters communicating program progress and achievements to a broad audience.

Further information about NOAA's Climate Program can be found at: http://www.climate.noaa.gov. A more detailed job description and applicant instruction will soon be posted at USAJOBS http://www.usajobs.gov/ . This position is classified as Physical Scientist, ZP-1301-05, Salary Range $124,995 to $157,100. Open to all U.S Citizens.

The U.S Department of Commerce is an Equal Opportunity Employer.

Postdoctoral position in lunar magnetism at the Institut de Physique du Globe de Paris

The Institut de Physique du Globe de Paris (IPGP) is inviting applications for a postdoctoral position in the broad field of lunar magnetism. This one-year position (renewable for a second year) aims to decipher the origin of crustal magnetism by modeling spacecraft-derived magnetic field data. Potential research projects include modeling the direction of crustal magnetization, comparisons of derived crustal magnetization with measured properties of lunar samples, and correlations between magnetic anomalies and GRAIL gravity. As part of a larger project, the applicant will have the opportunity to collaborate with paleomagnetists, geophysicists, and geodynamo modelers at CEREGE (Aix en Provence) and ISTerre (Grenoble).

To apply, please provide a CV, publication list, contact information of two references, and a 2-page letter that motivates the applicant's interest in the topic and that describes prior relevant research experience. Please respond by email to Mark Wieczorek (wieczor@ipgp.fr) before March 23, 2015.

RESEARCH ASSOCIATE PROFESSOR (tenure track) Geothermal Specialist

The Nevada Bureau of Mines and Geology (NBMG) at the University of Nevada, Reno seeks applicants with expertise in geothermal energy research. Nevada is one of the most exciting regions in the world to do research in the geosciences and one of the best in the U.S. for the study of geothermal resources.

Position Responsibilities: The primary responsibilities of this position will be to develop broad programs in research and education in the field of geothermal energy while serving as Director of the Great Basin Center for Geothermal Energy. The applicant is expected to conduct a nationally competitive research program that will include innovative approaches to understanding the complexities of fluid flow in the crust with a concentration on Nevada and the surrounding Great Basin region. The successful candidate will also be expected to contribute to the development of datasets and reports on Nevada's geothermal resources, maintain geothermal databases as part of NGDS (National Geothermal Data System), and provide state resource assessments. Education will include teaching courses in geothermal related topics in the Department of Geological Sciences and Engineering (DGSE), supervising graduate students, and contributing to developing a geothermal curriculum. Research and educational efforts will involve multi-departmental and multi-institutional efforts, with scientists from academia, industry, other institutions, and government labs. The successful candidate will be asked to communicate effectively with the public and community leaders regarding the geothermal resources of Nevada.

Qualifications: Applicants must have a doctorate in geology, geologic engineering, geophysics, reservoir engineering or a related geoscience or engineering field by the time of hire and a demonstrated record of research on topics related to geothermal energy as indicated by funded research, industry experience, and/or peer-reviewed publications. The successful candidate must have at least 5 years of experience in geothermal research in such areas as rock mechanics, 3D modeling, geophysical techniques, reservoir engineering, and/or geochemistry. Excellent communication skills, as demonstrated in written application materials, commitment to public service, established record of publications, and ability to attract funding are essential. The successful candidate must also have demonstrated ability to develop/coordinate programs and work in teams to accomplish major goals.

Because the individuals will be competing for funding from a variety of sources, including industry and federal agencies, for fundamental and applied geoscience research (e.g., NSF, DOE, and USGS), preference will be given to candidates who explain achievable plans for funded research on Nevada-focused topics in geothermal energy in their letters of interest. In addition, preference will be given to candidates who understand NBMG's role as the state geological survey of Nevada, especially to those who can articulate a plan of how NBMG can better serve stakeholders (citizens, government, and industry) on issues related to geothermal resources.

Salary and Date of Appointment: The position will be a tenure-track faculty appointment at the associate professor level with an academic-year base salary that is competitive with other research universities. Starting date will be July 1, 2015 or shortly thereafter, depending on availability of the successful candidate.

Application: Please submit a letter expressing your interest in the position and research plans; names, e-mail, postal addresses, and telephone numbers of at least three references; a complete vita; and electronic copies of up to three of your publications to https://www.unrsearch.com/postings/16685. Application deadline is March 1, 2015. For further information about NBMG, please consult our website (http://www.nbmg.unr.edu).

The University of Nevada, Reno is committed to Equal Employment Opportunity/Affirmative Action in recruitment of its students and employees and does not discriminate on the basis of race, color, religion, sex, age, creed, national origin, veteran status, physical or mental disability, and sexual orientation. The University of Nevada employs only United States citizens and aliens lawfully authorized to work in the United States. Women and under-represented groups are encouraged to apply.

The stable isotope lab at Duke (DEVIL) seeks new clients for 13C,15N, 2H and 18O analyses. Quick turn-around for EA, GC-C, TCEA, dual inlet, GasBench. 20% discount for first-time clients. Contact Jon Karr at jkarr@duke.edu or 919-660-7418.http://nicholas.duke.edu/devil/

Two Job Openings: Computational Earth Science Group, Los Alamos National Laboratory

Deputy Group Leader, Computational Earth Science Group, Job ID# IRC37040 This position is 50% management and 50% technical/science in either atmospheric modeling or subsurface flow and transport modeling. Scientist 3/4: Subsurface Flow and Transport Modeling, Job ID# IRC36086 This position is for an experienced professional (generally greater than 5 years since degree) in the general area of computational hydrology, reservoir simulation, computational fluid dynamics or reactive transport. For full job descriptions visit the LANL web site: http://careers.lanl.gov

EOE

Student Opportunities

Call for PhD Student Applications: The Department of Forest Resources and Environmental Conservation at Virginia Tech is seeking a PhD student to lead research assessing the effects of emerald ash borer on the ecohydrology of black ash wetlands in the Great Lakes region. Applicants should have a M.S. in forest or wetland ecology, hydrologic sciences, environmental engineering, or a closely related field. This position involves extensive field work across the Great Lakes region, starts in fall 2015, and is fully funded for four years. Contact: Dr. Daniel McLaughlin (mclaugd@vt.edu).

PhD/MSc opportunities Queen's University

The Railway Ground Hazard Research Program is a collaborative effort among industry, academic institutions and the federal government of Canada. The program aims at developing innovative scientific and technical solutions to help railways manage the risks associated with ground hazards.

The Department of Geological Sciences and Geological Engineering at Queen's University is seeking graduate students (both Phd and MSc) to further develop and optimize methodologies for including remotely sensed data into a formal system to identify/characterize/monitor hazardous natural rock slopes. Specifically, we invite candidates with expertise or interest in InSAR/PSInSAR, photogrammetry, LiDAR, rock mechanics, and natural hazards to apply. Further information is available by contacting Prof. J. Hutchinson (hutchinj@queensu.ca) or Prof. A. Braun (braun@queensu.ca). To apply, please visit https://eservices.queensu.ca/apps/sgsapp/.

The Department of Civil and Environmental Engineering at Utah State University invites applications for a PhD-level research assistantship beginning summer 2015. This opportunity is part of an NSF-funded study focused on the influences of river regulation on groundwater/surface water interactions and instream water quality at large reach scales. Candidates should have an M.S. preferably in engineering, however those with degrees in related fields will also be considered. Please contact Dr. Bethany Neilson (bethany.neilson@usu.edu) for more information.

Postcards from the Field

Dear Everyone,

The end of a long day in the field was rewarded with a pretty good aurora for this time of the year!

Felix W. von Aulock, with researchers from Volcanology Liverpool (@VolcanoLiver) and LMU Munich Volcanology (@LMU_Volc)

View more postcards at *http://ame=ricangeophysicalunion.tumblr.com/tagged/postcards-from-the-field.*

American Geophysical Union

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Awards

Ambassador Award

Edward A. Flinn III Award

Charles S. Falkenberg Award

Athlestan Spilhaus Award

International Award

Excellence in Geophysical Education Award

Science for Solutions Award

Robert C. Cowen Award for Sustained Achievement in Science Journalism

Walter Sullivan Award for Excellence in Science Journalism – Features

David Perlman Award for Excellence in Science Journalism – News

Prizes

Climate Communication Prize

NEW The Asahiko Taira International Scientific Ocean Drilling Research Prize

Medals

William Bowie Medal

James B. Macelwane Medal

John Adam Fleming Medal

Maurice Ewing Medal

Robert E. Horton Medal

Harry H. Hess Medal

Inge Lehmann Medal

Roger Revelle Medal

Fellows

Scientific eminence in the Earth and space sciences through achievements in research, as demonstrated by one or more of the following: breakthrough or discovery; innovation in disciplinary science, cross-disciplinary science, instrument development, or methods development; or sustained scientific impact.

Nominations Deadline: 15 March

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